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Our Primary Problem

GREAT as is the importance of technical problems, it is undeniable that the greatest modern puzzle of all is economic. This generation has seen ups and downs that have put a severe strain upon nerves and financial resources alike. As we look back upon our industrial history we find that we have not been altogether exceptional in that respect and that trade has always been subject to cycles of depression. There can be no doubt that to-day we are engaged in something that is hardly distinguishable from a "boom" period. Before the munitions and rearmament programme commenced our steel output was the greatest in our industrial history. There are those who hold that we have now got back to normal conditions following the inevitable aftermath of every great war. Those people, however, seem to overlook the change in conditions.

Contrast the difference in conditions between to-day and the after-period of the wars of the nineteenth century. In those days there were a number of favourable factors that either do not operate now or that operate with much reduced power. The population of the civilised world was then increasing rapidly so that as fast as goods could be produced in larger quantities they could be sold; to-day the white races bewail their shrinking numbers. Britain was the workshop of the world; to-day all civilised (and some semi-civilised) nations are preaching economic self-sufficiency, which means in effect: "I shall try to sell what I can throughout the world, but I'll take good care not to buy anything." The world is, therefore, to-day economically mad, whereas in the nineteenth century it was economically sane—or, at least, relatively sane. The wild and unpopulated spaces of the world were being opened up for colonisation; to-day few nations welcome the colonist, and the British Empire finds difficulty in accommodating even the best class of emigrant from these islands. Then, the purchasing power of people was increasing; to-day that factor is either non-operative, or is hardly likely to have any considerable value in the sale of additional quantities of goods. Income tax, rates and public expenditure were then so low as to make very little difference between the net and gross income. To-day, we can reckon that any man who really has the initiative to earn a good income, say, between £1,000 and £2,000 a year, must work for the Government for two months out of the twelve, whilst the captains of industry whose income runs up to the supertax levels, are allowed still less of the fruits of their labour; this state of affairs is apt to stifle initiative when it may be most needed.

Our problem to-day, therefore, is the difficult one of finding means whereby we shall not suffer from industrial slumps as we did in the past, having in mind the fact that most of the favourable factors which might have been expected to reduce the tendency to extreme trade fluctuations seem to be no longer operating. One of the difficulties is inherent in human nature. How many are there who, when there is no trade, take the opportunity of quick deliveries, low prices and favourable opportunity in their own works to equip themselves for the trade "boom" that will be coming later? There are some few who do this, but their number are very few. The result is evident now. Many firms, having waited till their works were busy, are now feverishly installing plant that should have been put in between 1930 and 1934, are finding that prices have soared, and are blaming the manufacturer for demanding such greatly increased figures. As a result, we are being carried into the well-known vicious spiral of increased prices, wages, costs, and all the consequences in industrial disputes, inflation, and disorganisation with which we are so familiar from painful experience.

There can be little doubt that one of the consequences that will follow from the events of the present is the decreased working day. This country has been chary of making moves in that direction, even though every student of industrial history could see that it was the only likely way in which the unemployment problem could be tackled permanently. The announcement that the steel industry of America has adopted the 40-hour week, and many other similar occurrences, show the direction in which events are moving. Unquestionably, if the shortened working week is worked honestly by all—by foreign nations as well as in America and Britain, by firms of every size and in respect to highly-paid employees as well as to clerks and workmen—it will solve the problem of making the work go round. Industrial history has shown a continuous shortening of working hours, and common sense, aided by a perception of the potentialities of invention, suggests that this movement will continue. Some common method of spreading out the work, which in this age of dictators might be easier to arrange than at any other time during the past 150 years, will minimise the effect of trade depressions upon the wage earner.

This is a problem to which the scientific man and the industrialist should alike give the most anxious thought. To-day in the rush of business it is difficult to give thought to anything beyond the day's work, but now, when we are momentarily prosperous, is the time to plan for the future.

Notes and Comments

Voluntary Pensions

MANY black-coated workers in the chemical industry will welcome the new contributory Insurance Bill as a means of sharing with their lower paid colleagues the opportunity of making provision for pensions. Under the existing compulsory Acts the income limit is £250 per annum, but the income limits in the new Bill are £400 for men and £250 for women, with an age limit of 40 for admission to the scheme, except in the first year, when a concession is allowed to enable workers up to 55 years of age to enter. The scheme has been long awaited and there will be general satisfaction that at last a move has been made towards the realisation of the hopes of those who have been debarred from providing for pensions. It is estimated that the Bill will embrace from 1,000,000 to 1,200,000 people, but it is uncertain how many of the people whom it is desired to benefit will join. Nevertheless, there is need for some such development in the pensions system, especially as the general rise of wages is causing the income limit long since fixed to differentiate unfairly between well-paid artisans and moderately well-paid professional persons. The scheme, however, still leaves unsolved the problem of providing unemployment insurance for the same class of people—a problem to a large extent handled on a voluntary basis by the British Association of Chemists. The Association's scheme was examined some months ago by a committee that was investigating the question of raising the income limit for such insurance, and the Association was commended upon the success of its voluntary effort in that direction.

Weight Lifting

MCHANISATION in industry has gone a long way towards replacing the muscular Goliath of bygone days by the more agile and probably quicker-witted David of to-day, but even now, in spite of the change in personnel and in the equipment of the workshop, the human factor has not been eliminated and the problem of muscular action remains. There are few factories in which some lifting and carrying has not still to be done, and it is well, therefore, that the Factory Department of the Home Office should have deemed the problem of sufficient importance to issue a brochure indicating the extent and causes of accidents in weight lifting and drawing attention to methods of reducing them, with illustrations from some of the industries in which the lifting and carrying of heavy weights is frequent. Reference is made to the maximum loads which have been suggested for various classes of workers and to the legal restrictions on weight lifting in Great Britain. Special attention is given in the brochure to the problems of particular industries, and, although chemicals are not specifically mentioned, there are a number of cases in connection with the dyeing and finishing of textiles and the handling of goods at the docks which deserve attention. How important the matter is can be judged from the fact that in one quarter in 1933 there were 1,055 weight-lifting accidents against 948 in a similar period in 1929. The textile industries recorded 63 weight-lifting accidents in the earlier and 76 in the later period.

Wear and Tear Allowances

THE new year so far as income tax assessment is concerned commences next Tuesday, and attention is therefore being turned to the preparation of the annual returns, with special regard, in the case of chemical manufacture, to the questions of wear and tear, renewals, obsolescence and losses. Although no account is taken of the rates of depreciation shown in the balance sheets of companies, which are governed by individual circumstances and accounting methods, elastic allowances are made for machinery and plant. For wear and tear an allowance is given by way of a yearly percentage on the written down value; for obsolescence an allowance is given for the cost of replacing old machinery by new, less any allowance for wear and tear, and for renewals (mostly small articles come under this rule) the entire cost is allowed after the first outlay. Certain wear and tear percentage rates have been arranged, these differing according to the process machinery and plant of the particular trade. In most cases for fixed plant such as engines, boilers and shafting the rate is 5 per cent., plus one-tenth, and for electrical plant the rate is 7½ per cent., plus one-tenth. Broadly speaking, the allowance for sulphuric acid plant is 15 per cent., chemical plant (other than sulphuric acid), 7½ per cent., and for other plant, 5 per cent., subject to the additional one-tenth in each case.

Ideas Sometimes Overlooked

A NEW metal has been announced. It differs from the more common copper alloys in one important respect. It actually *combines* high strength, toughness, corrosion resistance, and ease of welding. Such may be your summary of a paragraph which has been published in the trade papers. Why not write for still further information; subconsciously you know that such a metal should interest you. One or more of the features specified exists among the copper alloys which are at present available—so far as your own knowledge goes. But here is a metal which seems to be different in that it offers a combination of all the features which you have been enumerating on your finger tips. The task of writing a short note requesting the name and address of the supplier if not given, or asking the known supplier for further information, will not occupy much of the office time, and postage at three-halfpence is good value for that service. Many a valuable idea has been overlooked because the potential user has been too prone to read the story just so far as the supplier has given it in his advertisement, or to the extent that comment has been made in the editorial columns. Remember that space is limited in the trade papers; remember that the users for a new constructional material, plant feature, or product, may be numerous—possibly even beyond the experience and imagination of the supplier. Look up the details, consider them from your own point of view as a possible user. You may be surprised to find that industrial brains are really very clever; that development and production upon a commercial scale has been a blessing to users, in addition to a source of profit for the inventor and manufacturers.

The Co-ordination Theory in Pigments

A Matter of Scientific Interest and Technical Importance

IN addition to tinctorial power a good pigment must possess durability, covering power, body, fastness to light, and stability towards oily or aqueous media, said Mr. F. H. Burstall, M.Sc., of the Chemical Research Laboratory, Teddington, in a paper read at the March meeting of the Oil and Colour Chemists' Association. It was not unreasonable to suppose that those properties could be correlated with chemical structure. Accordingly, the determination of the constitution of pigments was a matter of both scientific interest and technical importance.

In a brief survey of the co-ordination theory Mr. Burstall referred to the difficulties encountered by chemists in the latter part of the last century in providing an explanation for the existence of large numbers of compounds to which the principles of integral valency could not be applied satisfactorily. Such anomalous derivatives were sometimes termed molecular compounds.

The Work of Alfred Werner

He went on to refer to the work of Alfred Werner, who in 1891 had abandoned that conception of fixed valency, and had assumed that the chemical affinity of an atom could be divided up in various ways into units of different intensities. In 1893 Werner had applied those ideas to the constitution of inorganic compounds, to which he had ascribed two types of valency—principal valency, which is now recognised as electrovalency, and co-valency and subsidiary valency, which is now called co-ordination co-valency or co-ordination linking. Moreover, the number of atoms or molecules with which an element became associated was an important feature, as well as the nature of such atoms or molecules. That number was the co-ordination number of the atom and was usually four or six, but frequently had some other value, generally between one and eight. When a number of associating groups became attached to a central atom, a co-ordination complex was formed—a kind of chemical merger in which the personality of the constituent atoms or molecules was suppressed in favour of that of the complex as a whole.

A survey of the simple inorganic pigments, continued Mr. Burstall, indicated that technical products were frequently mechanical mixtures of two or more chemical individuals; lithopone, for example, was a mixture of zinc oxide, zinc sulphide and barium sulphate. Inspection of a representative list of the more important substances which were either used or had been used as pigments, or were constituents of complex mixtures, revealed the presence of apparently simple compounds such as the metallic oxides and sulphides, which at first sight seemed hardly justifiable inclusions among co-ordinated structures. The solid substances were polymerides of high and unknown molecular weight. The complexity of those compounds became evident on consideration of their crystal structure as determined by X-ray analysis.

Crystal Arrangement of Zinc Sulphide

In the crystal arrangement of zinc sulphide, the lattice was cubic and of the diamond type. Each sulphur atom was surrounded by four zinc atoms which were situated at the corners of a tetrahedron, and each zinc atom was at the centre of a tetrahedron of sulphur atoms. A similar arrangement of atoms was revealed in the crystal structures of cadmium sulphide and telluride and mercuric sulphide (vermilion). In zinc oxide and cadmium selenide the lattice was hexagonal, but an equal number of metal atoms and non-metallic atoms surrounded each other as in the former example. Titanium dioxide possessed a tetragonal cell in which each titanium atom was surrounded octahedrally by six oxygen atoms, whereas each oxygen had a group of three titanium atoms around it. Stannic oxide (the anhydrous form of tin white) and manganese dioxide (manganese black, and also present in raw

umber) also possessed that crystalline constitution. The structures of ferric oxide (red ochre) and chromic oxide (viridian) were more complicated, but the unit cell was tetragonal and each metallic atom had six oxygen atoms arranged round it, while the oxygen atoms each had four metal atoms.

Those regularities in the number and arrangement of atoms recalled the early teaching of Werner on the co-ordination theory, and it was only reasonable to assume that there was some interchange of electrons between an element and its surrounding atoms. Indeed, it was probable that the distribution of electrons between a number of atoms played an important part in determining the type of crystal form which arose when elements combined. Those ideas regarding crystal structure and atomic combination could also be applied to other substances which were used as pigments, but he referred to six products which were represented by the more familiar and conventional formulae. In barium sulphate and manganate two oxygen atoms in each structure were regarded as attached by co-ordination links. In lead chromate a covalent attachment was assumed, since it was known that in organic compounds of chromium a covalency of at least four must be present. The central-lead atom in red lead was quadrivalent, whereas the other two were bivalent. In white lead it was assumed that lead hydroxide was co-ordinated through the oxygen atoms of the hydroxyl group to lead carbonate. In cobalt yellow the characteristic six-point arrangement was manifested. Three of the nitrite groups were co-ordinated to cobalt and the other three co-valently attached to the metal.

Constitution of Prussian Blue

The constitution of Prussian blue and that of related pigments, were determined recently with X-ray analysis by Keggins and Miles. Prussian blue had a cubic lattice with ferrous and ferric atoms alternately at the corners of the cube, while the cyanogen radicals were situated along the edges of the solid figure. The alkali atoms appeared at the centre of alternate cubes. It was probable that both ferric and ferrous atoms were co-ordinated with the cyanogen groups like $\text{Fe}-\text{C}\equiv\text{N} \rightarrow \text{Fe}-\text{N} \rightleftharpoons \text{C} \rightarrow \text{Fe}$ or $\text{Fe} \leftarrow \text{N} \rightleftharpoons \text{C} \rightarrow \text{Fe}$. Ruthenium purple, $\text{RFe}[\text{Ru}(\text{CN})_6]$, in which the metal ruthenium replaced ferrous iron, possessed a similar structure. Oxidation of Prussian blue led to Berlin green, $\text{Fe}[\text{Fe}(\text{CN})_6]$, which contained only ferric atoms and no alkali metal, while the cyanogen groups occupied the edges of the cubic structure as in the former case. That pigment was derived from alkali ferricyanide, $\text{R}_3[\text{Fe}(\text{CN})_6]$, which manifested the same arrangement of atoms as the lower valent analogue.

With regard to the metallic lakes of mordant dyes, Werner had suggested thirty years ago that they were internal co-ordination complexes, and experimental proof of that significant suggestion was later obtained by Morgan and Main Smith, who used some of the cobaltamines as proofs in the determination of the constitution of colour lakes. The anthraquinone series afforded many examples of the formation of complex chelated derivatives containing metals. A good example of considerable stability associated with co-ordination was Diamond Black PV X, which furnished an un-oxidised chromium lake with chromium fluoride, whereas with a chromate an oxidised product of great fastness to potting was produced. More complicated metallic lakes could also be formed with suitable dyes as exemplified by the copper pigment obtained from Sky Blue FF. The essential feature in the mordant lakes, an immense number of which were used as pigments, was the formation of a stable five or six membered ring system in which the metal was implicated.

Another series of important pigments of a different type were the Fanal pigments, which were produced by precipitating basic dyes such as Auramine with phosphotungstic or

silicotungstic acids having the formulae $H_5[PO_4(W_{12}O_{36})]_5H_2O$ and $H_4[SiO_4(W_{12}O_{36})]xH_2O$ respectively. Those heteropoly acids possessed an interesting co-ordinated structure in which the central atom (P or Si, etc.) was tetrahedrally surrounded by four oxygen atoms. Upon that tetrahedron was built a superstructure of twelve interlocking octahedral WO_6 units which were divided into three groups. In each WO_6 unit, one oxygen atom was held in common with the central atom (P or Si) and was also shared by two other WO_6 units, two more were shared between tungsten atoms in its own group of three octahedra, two more with the two remaining groups of three WO_6 units and one was unshared by other atoms. The corresponding phosphomolybdic and silico-molybdic acids had a similar structure and were used in the production of Fanal pigments.

One of the most interesting and valuable of synthetic colouring matters produced in recent times was Monastral Fast Blue BS I, which was the copper salt of phthalocyanine, recognised by Linstead and his co-workers in 1934. That copper salt, produced by heating phthalonitrile (1:2-dicyanobenzene) with copper, was stable at over 500° and possessed other desirable properties which added to its importance as a pigment. The molecule had a planar configuration and acted as a quadridentate co-ordinating unit. The corresponding lead compound was green and appeared to have a promising future as a pigment.

Constitution of Ultramarine

The constitution of ultramarine, and even its composition, were matters of considerable uncertainty. The pigment, which occurred naturally in lapis lazuli, was prepared by heating a mixture of china clay, sulphur, sodium carbonate, silica and a reducing agent such as resin, pitch or charcoal. Although several empirical formulae had been proposed for ultramarine, the most probable were $Na_2[Na_6Si_6Al_6O_{24}S]$ for the blue pigment and $Na_2[Na_6Si_6Al_6O_{24}S_2]$ for the green. The sodium atoms outside the bracket indicated the more easily replaceable alkali atoms, but it was possible to replace all the alkali metal under drastic conditions. Aluminium and silicon atoms could replace each other without much alteration in the structure, and that fact increased the difficulty of obtaining a pigment of definite composition. It was known that suitable treatment of a zeolite with alkali polysulphide led to a blue product similar to ultramarine. In 1935, Gruner had obtained an ultramarinelike product from permutite in successive stages.

In conclusion, Mr. Burstall said that if it were accepted that the arrangement of atoms in a crystal was determined at least in part by the electronic distribution among those atoms as manifested by valency (co-ordination, covalent or electrovalent), then the mechanical attributes of compounds became more readily correlated with fundamental properties of its atoms. Covering power might be connected with the shape and hardness of the crystal and its mode of cleavage on grinding, and "body" with the density of atoms within the cell. Those ideas might seem rather speculative and should be regarded as pointers to the way in which a knowledge of atomic structure might assist the pigment chemist. In spite of all the powerful weapons of research at our disposal, valuable products still arose by accident, as was the case with phthalocyanine, which first appeared as a ferruginous impurity in the manufacture of phthalimide from phthalic acid and ammonia in an iron autoclave.

Points from the Discussion

The PRESIDENT (Dr. G. F. New), who was in the chair, congratulated the author upon a most stimulating paper, and said that he had been taught to regard co-ordination as extremely abstruse, but it appeared that everything in the chemical world was co-ordinated. With regard to Prussian blue, on which Keggin and Miles had published some interesting results, he said that work of that kind had been done also in the research laboratories of the Research Association of British Paint, Colour and Varnish Manufacturers, though by a different approach, either before or simultaneously with the work of

Keggin and Miles. That work was very important, and the Research Association deserved credit for it.

Dr. L. A. JORDAN (director, Paint Research Station) was gratified to learn of the respect the author had for Werner, whose work and hypothesis had stood the test of from 30 to 40 years. As a student in 1909 Dr. Jordan had prepared, as a vacation exercise, specimens of nearly every cobaltamine and chromeammine described by Werner up to that time, because he was interested in the real chemistry displayed by Werner's work, and also because he was fascinated by the colours of the compounds. The range of pastel shades in the cobaltamine series was really beautiful, and those old specimens were still a prized possession. Important developments in the supply of pigmentary compounds were still to be expected from the complicated molecular types containing metals and known as co-ordinated compounds, of which Monastral Blue was a very practical example.

Iron Oxide Pigments

Commenting on the author's reference to iron oxide, Fe_2O_3 , as having a hexagonal structure, Dr. Jordan said that the story of the iron oxide pigments was not quite so simple. The subject had been studied by the National Physical Laboratory and the Paint Research Station jointly by applying the method of X-ray crystal analysis to the examination of the precipitated iron hydrates and the pigments produced by heat treatment at temperatures up to $1,000^\circ C$. First, precipitated ferric hydrate was invariably found to be the monohydrate and its structure was orthorhombic or (less frequently) cubic, according to the manner of formation; any water present over the stoichiometric requirement of the formula $Fe_2O_3 \cdot H_2O$ was adsorbed or otherwise attached in a loose manner. The two naturally occurring forms of that material were goethite (α -hydrate) and lepidocrocite (α -hydrate), which latter was also orthorhombic in crystal form. On heating the orthorhombic form of $Fe_2O_3 \cdot H_2O$ nothing much happened below $200^\circ C$, but thereafter water was lost rapidly. Gradually the material was found to have the chemical composition Fe_2O_3 with the cubic structure corresponding to that usually associated with Fe_2O_4 . At about $500^\circ C$. the beginning of a second transition could be detected and gradually the material, still of the chemical composition Fe_2O_3 , assumed the rhombohedral structure normally associated with massive Fe_2O_3 .

Dr. R. BHATTACHARYA said it appeared that in the co-ordinated compounds there was only a small amount of inorganic metal, as compared with a large proportion of other elements present. Chlorophyll Monastral Blue, for instance, had only a minor trace of magnesium or copper in the molecule. When all the valencies were fully saturated by that minute quantity of metal, there was a sudden change in the shade or colour as the result of substituting one of those metals by another, and he asked what was the explanation of that change. Zinc ultramarine was colourless. He asked whether there was any theory to associate the colour of a particular lake with a particular metal.

Stability to Light

Mr. BURSTALL said he did not think there was any definite explanation of that anomaly; it did not always occur. Sometimes, by substituting one metal for another, one obtained practically the same tint. It was just possible, however, that it might be connected with the different electronic structures of the elements concerned. In the case of ferrocyanine, of course, the organic molecule could not change very much; it was practically a rigid structure and it could not expand or contract.

Mr. J. L. KING said it was curious that most of the co-ordination compounds were extraordinarily stable to light, etc. It seemed to him that the co-ordinate link of itself should not be so stable a linkage as, say, an ordinary covalent one or certainly an electrovalent one.

Mr. BURSTALL, referring to the Fanal pigments, said that co-ordination might occur between the acidic part of the complex acid and the basic organic molecule. In that case it

would probably take place through the hydrogen. Of course, co-ordination of hydrogen was rather a special case; usually, on account of the fact that hydrogen could not take up two electrons, it seemed to perform co-ordination by some other process, such as isomerism. That might explain the stability, and so on, of the Farnal colours. Co-ordination links were usually associated with a decrease of stability as compared with the others; but that was not always the case. It seemed to depend on other factors as well. The co-ordination link between any two atoms might be quite different from that between two others; for instance, between cobalt and ammonia and between cobalt and sulphur there seemed no particular reason why it should hang on to ammonia so very tightly and yet did not co-ordinate nearly so well with sulphur-containing molecules.

Mr. WORNUM, commenting upon Dr. Jordan's difficulties concerning fastness to light, suggested that by co-ordination one was able to fix a structure, and therefore maintain the chromophore grouping of the molecule. He asked if it were a probability that if one could fix the structures that were desired by some form of co-ordination, that might very readily lead to greater permanency to light.

Mr. BURSTALL replied that that was quite reasonable in certain cases, particularly among the metallic lakes and mordant dyes. Some of them were very stable, and the fixing of the structure in the manner suggested might very well play quite a large part in maintaining stability to light and to chemical decomposition in various ways.

The PRESIDENT said he had understood that all electrons were parts of a system like a small solar system; he did not

know whether there was any physical basis for regarding an electron as a fixture in any of the pigment structures. If there were movement, the system was dynamic; all sorts of new forces were introduced, and, just as in large-scale matter, there were gyroscopic effects which introduced quite new resistances to motion. By reason of the unsaturations there might be conceivably some rotational system which was extremely resistant to disturbance.

Mr. BURSTALL said he did not think those theories were incompatible. In the electronic structure of an atom one might expect the outermost to be the more mobile, and combination would tend to restrain them to some extent probably. Apparently some were more mobile than others. By taking sufficiently drastic steps one could get quite a lot off, as physicists had done, by various electrical means; apparently one could strip them almost completely, though a tremendous amount of energy was needed to do that. In the alkali metals one electron was so far away from the rest that it was only too glad, so to speak, to find a home and combine with some other element.

Dr. JORDAN suggested that it might be wise to regard the diagrams as instantaneous photographs, showing in stationary positions the electrons which ordinarily were moving, just as an instantaneous photograph of couples who were dancing did not give the appearance of movement. He asked if there were any kind of balance condition at all.

Mr. BURSTALL said that modern views rather supported the conclusion that there were changes taking place continually, so fast that one could not assume any one structure as being fixed.

Electron Diffraction

Its Application to Industrial Problems

THE "electron diffraction camera" represents the practical application of one of the most abstruse of scientific discoveries, said Professor G. I. Finch, of the Imperial College of Science and Technology, London, in opening a discussion on "The Application of Electron Diffraction to Industrial Problems," at the 2nd Conference on Industrial Physics at Birmingham, on March 19.

It was in 1924 that the Due de Broglie put forward, in mathematical form, the theory that just as light had been shown to behave in some ways as particles, so matter which was traditionally regarded as consisting of particles might be capable of behaving in some ways as waves. In the same year in America, another scientist, Davisson, stumbled on the fact that electrons did so behave. He found that a beam of electrons was scattered at a crystal surface giving a diffraction pattern, analogous with those produced by an optical grating, or more directly with those obtained in the study of crystal structure by means of X-rays. This observation, confirmed by Professor G. P. Thomson in this country, is one of the essential foundations of the modern mathematical theory of the atom.

Mechanism of Lubrication

The "electron diffraction" method of analysis is now becoming of practical importance for the study of the mechanism of oil lubrication, and structure of electrodeposited nickel. Whereas X-rays penetrate deeply into solid materials it is a property of the electron beam used in the "camera" that penetration is confined to the first few layers of atoms in the material which is being examined (less than one-millionth of an inch). It is, therefore, only the surface structure which is shown. It was this distinction which conditioned the type of problem to which the electron diffraction method could be usefully employed.

In the electron diffraction camera a parallel beam of high-

speed electrons (30-70 kV) is allowed to fall at grazing incidence upon a surface, or passed normally through a sufficiently thin film, and the resulting diffraction pattern is first observed visually on a fluorescent screen, and then recorded upon a photographic plate.

A study of thin films of oil shows that the long chains of a normal saturated hydrocarbon stand vertically up from the surface. This suggests a system which, mechanically, would be liable to sudden collapse, when the oil film is pressed between two surfaces. If, on the other hand, the oil contains a certain amount of "polar" hydrocarbons, in which the two ends of the chain are different, then the chains tend to be arranged at an angle to the surface (about 60°, although the angle varies with the oil). A system is thus suggested which would not collapse suddenly but would have resilience. The effect of pressure between the two surfaces would merely be to reduce the angle at which the chains are arranged, to flatten them out. It is suggested that this is the reason why oils of the second type are to be preferred.

In examining the structure of electrodeposited nickel, micrographical examination alone might lead to false conclusions. It might be concluded that the structure of the substrate was continued in the nickel layer, whereas the electron diffraction method showed that the surface nickel had reverted to a different structure. While his own experiments had been confined to the study of thin films of nickel on copper, Professor Finch urged that such findings implied that electron diffraction should now be regarded as an essential method in the study of electrodeposited layers.

IMPORTS for consumption of crude glycerine into the United States registered an increase in 1936, according to preliminary data, to 1,112,554 lb. value at \$1,190,360 from 8,220,934 lb., value \$656,734. Cuba contributed in 1936, 2,159,741 lb., value \$230,340 compared with 2,550,617 lb., value \$228,011 in 1935.

Hydrogenation Products of Coal and Oil*

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THE production of gasoline by thermal cracking of petroleum oil is a major industry in the United States. Thermal decomposition of coal is also carried on throughout the world on a large scale, though chiefly for the production of coke and gas. By-products of this operation are tar and benzene; the latter is now an important motor fuel. However, in comparison to the high yield of low-boiling products from petroleum, usually only a small amount of liquid material may be produced from coal. This is obviously due to the fact that petroleum contains twice as much hydrogen as coal and also that, in the decomposition of coal, hydrogen also is consumed, to some extent unintentionally, by the abundance of foreign elements such as oxygen, nitrogen, and sulphur. Therefore in the thermal treatment of coal, the

final products by adding the deficient hydrogen, without the necessity of forming at the same time a large amount of high-boiling or even solid condensation products. Besides the direct hydrogenation of coal, the hydrogenation of tars is important for motor fuel production. In Germany, for instance, tar from the carbonisation of high-bitumen lignites (with a tar yield of about 15 per cent.) is now converted by catalytic destructive hydrogenation into motor fuels, whereby a large percentage of the carbonisation coke may be used in the hydrogenation plant, especially for the production of hydrogen.

Several papers have been published (*4, 6*) on the fundamentals and the operation of the catalytic destructive hydrogenation. Raw materials such as petroleum, shale oil, tar, or coal can be treated equally well for maximum yields of motor fuels; gas is practically the only by-product. This gas may be easily reconverted into hydrogen. The process is not dependent on the solubility of by-products and avoids waste of raw material. It is also possible to regulate to a great extent the type of final product desired, with the result that an equally great variety of final products can be produced from the large variety of raw materials.

Choice of Reaction Conditions

The treatment with hydrogen at elevated temperature and pressure in the presence of catalysts effects an increase of the hydrogen content and at the same time decreases the size of the molecule to a certain extent. By suitable choice of the reaction conditions, such as catalyst, pressure, and temperature, hydrogen is added to an amount as determined by the desired final product. The reaction can be limited, for instance, to the removal of oxygen, nitrogen, and sulphur, or it can be extended also to the hydrogenation of olefins or even aromatic nuclei. The original character of the raw material will be conserved to a large extent in the products, retaining such valuable properties as high knock rating, ready ignitability, good lubricating value, etc. In view of this ability, the process of catalytic hydrogenation differs from other processes, such as the methanol process (*5*) carried out by the Badische Anilin und Soda-fabrik on a large commercial scale since 1923, and the Fischer process (*1*). In both of these processes the first step is the complete gasification of the raw material, followed by a reconversion to the liquid final product. The latter consequently cannot retain any features of the original raw material, since its structure has been completely destroyed.

Methods of Operation

Catalytic destructive hydrogenation has already found commercial application in several countries. In the United States its use has been studied in the oil industry for the improvement of lubricating oil and illuminating oil and for the production of gasoline, solvents, and special products (*3*). In Germany gasoline from lignite, lignite tar, bituminous coal tar, and petroleum oil has been produced extensively by this process. A plant for the production of gasoline from bituminous coal is just coming into operation at the present time (*6*). In England the production of gasoline from bituminous coal and bituminous coal tars is carried out in the same way (*2*).

This process depends on the addition of hydrogen to the raw materials at high pressure and elevated temperature in the presence of catalysts immune to sulphur poisoning. Catalysts of various kinds and shapes are used according to the desired purpose. High-boiling materials are hydrogenated in the liquid state in the so-called sump phase, light-boiling oils are treated in the vapour state in the so-called gas phase.

Hydrogenation in the gas phase was developed first. The



Fig. 1. Hydrogenation Furnace.

lower boiling products (with a higher hydrogen content) can be formed only to an insignificant extent, with the result that sufficient demand and use for the major product, coke, is necessary in order to make the carbonisation of coal economically feasible.

Countries with no or only small petroleum reserves, but with large coal deposits, thus have a raw material suitable for the production of oils. Thermal decomposition alone, however, is not sufficient to satisfy the present large demand. A process giving better yields is needed.

Catalytic Destructive Hydrogenation

For the production of motor fuels and oil, the process of catalytic destructive hydrogenation at elevated pressure has been developed in Germany. This process makes it possible to convert the raw material almost completely into low-boiling

* From a paper presented before the Division of Gas and Fuel Chemistry of the American Chemical Society; reprinted from "Industrial and Engineering Chemistry," February 1937.

gas phase conditions are easier to survey and give a clearer picture. The catalyst used in this operation is in lumps rigidly arranged in the reaction vessel. The raw materials suitable for treatment in the gas phase are such that they will not cause any condensation on the catalyst which might reduce its activity. Oils are preferred which have already been treated by some process—such as, for example, distillation or hydrogenation in the sump phase. The splitting of gas oil or middle oil to gasoline is carried out in the gas phase at about 400° to 500° C. The life of the catalyst is extremely long, exceeding one year.

Use of Rigidly Arranged Catalyst

The use of a rigidly arranged catalyst is not limited to the hydrogenation in the gas phase. This method of operation can be applied also to the treatment of high-boiling materials which have to be hydrogenated in the liquid phase, as long as the activity of the catalyst is not impaired by the formation of condensation products on its surface. For instance, the improvement of the viscosity-temperature relation of lubricating oils is carried out by mild hydrogenation in the sump phase with a solid catalyst.

For some high-boiling feed stocks this mode of operation may be applied only under certain conditions. Since such stocks in many cases contain components tending to form asphalts at elevated temperature and thereby cause a rapid decline of the activity of the catalyst, it is often advantageous to use the catalyst in such a manner that it may be continuously renewed in the reaction vessel. For this purpose pulverised catalyst finely distributed in the raw material is fed together with the latter to the reaction vessel and taken out again after it loses its activity. This method of hydrogenation in the sump phase is used not only for the treatment of heavy oils rich in asphalt and in sulphur, such as cracking residues and tars, but also for the treatment of coal which is made into a paste with oil for this purpose.

In this operation the catalyst concentration in the oven is usually small. In some special cases the life of the catalyst may be considerably longer, and the catalyst may then be accumulated in the oven to a concentration of about 25 per cent.

The hydrogenation in the sump phase with a small amount of finely distributed catalyst is especially important at present, since it represents the first stage in the production of gasoline from bituminous coal, lignites, tar, and oil. In all cases the process of operation is essentially the same, notwithstanding the great variety of the raw materials. Modifications are necessary only with coal because of its solid state and ash content. The products from the various raw materials show characteristic differences, however, especially those from coals as compared with those from oils.

Chemical Constitution of Coals and Oils

Products from both contain carbon and hydrogen as the main constituents, but they are different in appearance on account of their physical state. Examples of the chemical constitution of some coals and oils are as follows:

Ultimate Analysis of Ash- and Moisture-Free Substances	Bituminous Coals.				Petroleum Oil (with- out Gasoline)			
	Fat coal	Young gas coal	Lignite bitu- men	As- phalt base	Mixed base	Paraf- fin base		
C, %	86.7	82.8	65.2	71.9	84.6	86.5	86.0	
H, %	5.1	5.3	4.9	5.3	10.8	12.3	13.8	
O, %	5.9	9.3	27.9	16.3	0.5			
N, %	1.5	1.6	0.9	0.6	0.4			1.2
S, %	0.8	1.0	2.0	5.9	3.7			0.2
Volatile, %	29	38	56	61	95	99	99.5	
H/100 grams C:								
Grams	5.9	6.4	7.5	7.4	12.8	14.2	16.0	
Grams net	4.6	4.5	1.7	3.8	12.3	14.0	16.0	

The hydrogen content and especially the net hydrogen content of coals is markedly lower than that of petroleum oils. On the other hand, the coals contain more foreign elements such as oxygen, nitrogen, and sulphur. Also the coals contain inorganic substances to the amount of 2 to about 15 per cent.

which are left as ash after combustion. These substances are usually coarse in bituminous coals and finely infiltrated in lignite.

The ash content of the coals makes additional operating steps necessary. Since it is not possible to remove the ash completely from the coals and usually a few per cent. of the coal are left unconverted, representing the constituents least responsive to hydrogenation, some solid matter has to be removed from the hydrogenating oven and must be separated from the adherent oil. This separation is generally carried out by centrifuging or filtering, followed by carbonisation of the residue in the so-called sludge recovery plant. Economical reasons call for the greatest possible reduction in size of this plant, and it may therefore be of advantage to de-ash the coal before hydrogenation. This is done with the usual coal washing processes as in classifiers or by flotation. It is usually not possible to de-ash lignites mechanically; on the other hand, in this case the ash content may be of advantage for the hydrogenation.

Another method for the removal of ash from coal is provided by the coal extraction process (7). When coal is treated at elevated temperature with solvents—for example, tetrahydro-naphthalene and phenol—the coal is rendered soluble by

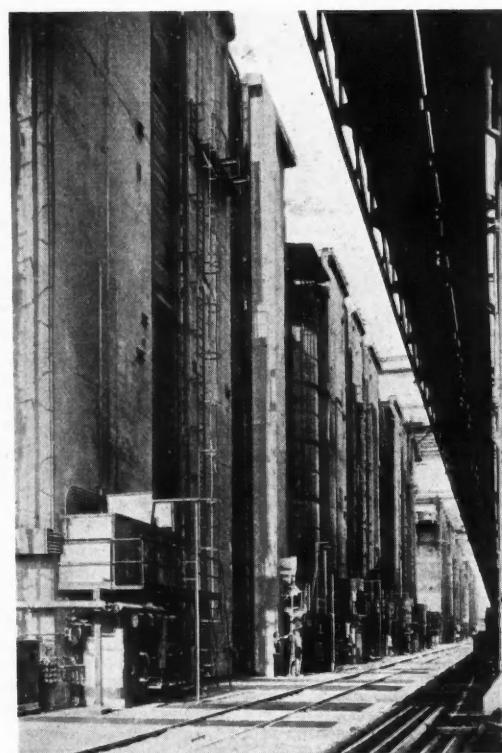


Fig. 2. High Pressure Rooms.

depolymerisation and hydrogenation, and the solution may be freed from ash and from the small amount of undissolved coal by filtering. The dissolved coal, which is practically free from ash, may then be hydrogenated in a similar way to an oil of high molecular weight.

Coal and extracts of coal are subjected in their entirety to the sump phase hydrogenation. With crude oils any lower boiling fractions can be hydrogenated directly in the gas phase, thus by-passing the preliminary sump phase hydrogenation.

Corresponding to their low hydrogen content, coals and coal products consume more hydrogen in hydrogenation than oils, since the difference in the hydrogen content of lower boiling finished products is small.

When coal is hydrogenated in the sump phase using small amounts of catalyst, the conversion takes place by way of

asphalts and high-boiling oils to middle oil and gasoline. The hydrogenation may be controlled to yield only asphalts or heavy oils, which can be used as fuel oil or for similar purposes. When gasoline is to be produced, the reaction conditions are controlled in such a way that the yield is largely middle oil and gasoline, while care has to be taken that a sufficient quantity of oil for the pasting of the coal will remain.

The nature of the sump phase products of any boiling range shows clearly the properties of the raw materials; this effect is the more marked, the less the molecule size is reduced. The extent to which asphalts produced by careful hydrogenation and depolymerisation of coal differ from one another and also from bituminous pitch and petroleum asphalts is apparent from the following table:—

	Pitch from Bituminous Coal.	Asphalt from Bituminous Coal.	Asphalt from Lignite.	Petroleum Asphalt.	
Ultimate Analysis.					
C, %	.. 93.0	89.0	85.0	83.2	
H, %	.. 4.6	5.6	8.2	9.2	
O, %	.. { 2.4	2.3	6.8 } 0.6	0.8	
N, %	.. 0.5			0.2	
S, %	.. 4.95	6.3	9.7	11.1	
Grams H/100:					
Grams C	.. 91.2	90.2	89.4	88.0	87.8
Boiling range, % :					
<225° C.	.. 12	26	29	24	32
225-250° C.	.. 38	48	48	45	55
250-300° C.	.. 81	87	86	87	93
300-325° C.	.. 100	100	100	100	100
Phenol, %	.. 8.1	16.1	21	13.6	Very low
Aniline point of middle oils freed from phenol, °C.	.. -10	-10	25	34	41
Sp. gr.	.. 0.952	0.942	0.908	0.900	0.876

The hydrogen content of the asphalts obtained by the hydrogenation of coal is higher than that of the coal pitch,

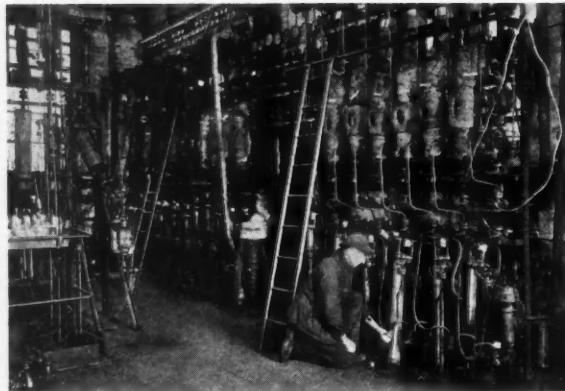


Fig. 3. Laboratory Furnace.

lignite contains 9.7 grams of hydrogen per 100 grams carbon—i.e., markedly more hydrogen than asphalt from bituminous coal which contains only 6.3 grams. The bituminous pitch produced by thermal treatment has the lowest hydrogen but lower than that of the petroleum asphalt. Asphalt from content.

Asphalt-free heavy oils have a higher hydrogen content than the corresponding asphalts:—

	Heavy Oil from :					
	Fat coal.	Young gas coal.	Low-bitumen lignite.	High-bitumen lignite.	Asphalt-base petrolium oil.	
Ultimate Analysis.						
C, %	.. 91.2	90.2	89.4	88.0	87.8	
H, %	.. 7.4	7.4	8.9	9.7	9.9	
O, %	.. 0.9	1.1	1.1	0.9	0.2	
N, %	.. 0.4	1.2	0.5	0.6	0.6	
S, %	.. 0.1	0.1	0.1	0.8	1.6	
Grams H/100 grams C	8.07	8.26	10.0	11.0	11.3	
Sp. gr. at 20° C. of fractions by vacuum distns.:						
200-225° C.	.. 1.042	1.024	0.988	0.967	0.934	
225-275° C.	.. 1.082	1.060	1.008	0.970	0.957	

Bituminous coal oils contain about 8 grams of hydrogen per 100 grams of carbon; lignite heavy oils, 10 to 11 grams; and the heavy fraction of asphalt base crude oil, 11.3 grams. The last, being the petroleum oil most closely related to coal, has been chosen for comparison. It may be noted that the heavy oil from the young gas coal rich in hydrogen has also some-

what more hydrogen than the heavy oil from fat coal. As the heavy oil from lignite with high bitumen content has more paraffin wax, the hydrogen content is also higher. Paralleling the increase in hydrogen content is the decrease in specific gravity of the vacuum fractions of the heavy oils, the differences in specific gravity tending to increase with increase of boiling point.

Similar characteristic variations are also found when the middle oils are considered. These in turn have a higher hydrogen content than the heavy oils:—

	Middle Oil from :			Asphalt-base petroleum oil.
Ultimate Analysis.		Fat coal.	Young gas coal.	Low-bitumen lignite.
C, %	.. 88.1	86.3	85.9	85.7
H, %	.. 9.7	9.5	10.5	10.6
O, %	.. 1.1	3.0	4.1	2.7 } 0.94
N, %	.. 1.0	1.1	0.8	0.6 }
S, %	.. 0.07	0.09	0.01	0.4 }
Grams P/100 grams C	11.0	11.0	12.0	12.4
Boiling range, % :				
<225° C.	.. 12	26	29	24
225-250° C.	.. 38	48	48	45
250-300° C.	.. 81	87	86	87
300-325° C.	.. 100	100	100	100
Phenol, %	.. 8.1	16.1	21	13.6
Aniline point of middle oils freed from phenol, °C.	.. -10	-10	25	34
Sp. gr.	.. 0.952	0.942	0.908	0.900

The hydrogen content per 100 grams of carbon changes from 11 grams with middle oil from bituminous coal to 12 grams with lignite middle oil, and finally to 14 grams with petroleum middle oil. Also in the oxygen content of the middle oils the differences of the original coals are still noticeable. With bituminous coal as well as with lignite, the coal with the higher oxygen content yields the middle oil with the highest amount of oxygen. The relatively high oxygen content of the middle oils is explained by their high phenol content. These phenols are either separated in order to permit their use as such or converted in the gas phase into gasoline. The different properties of the raw materials are also shown very well in the middle oils freed from phenols; the aniline point increases from about -10° C. for bituminous-coal middle oils to about 30° C. for lignite middle oils, and about 40° C. for middle oil from asphalt-base petroleum oil. The 50 per cent. point of the middle oils from all raw materials is about 250° C., middle oil from fat coal having relatively the highest 50 per cent. boiling point.

Even in the gaseous compounds produced by hydrogenation the properties of the coal may be recognised to some extent. The composition of the gaseous hydrocarbons from coal and petroleum oils is about the same, although the amount of oxygen which is combined with hydrogen or carbon differs.

For instance, bituminous coal yields about 5 per cent. of the oxygen as carbon oxides and lignite yields about 40 per cent. This combination of a large percentage of the oxygen with carbon instead of hydrogen results in a marked economy of hydrogen in the hydrogenation of lignite.

The relation of the products of sump phase hydrogenation to the raw materials is also expressed in the fact that the sump phase products from petroleum oil residues show great similarity to the straight-run products of the same boiling range, as is shown in the table for an asphalt-base crude oil:—

	Sump-Phase Hydrogenation Products from Heavy Ends of Same Asphalt-Base Crude Oil.				
	Dist. Products of Asphalt-Base Crude Oil.	Gaso-line oil.	Middle oil.	Heavy oil.	Heavy oil (dist.).
Ultimate Analysis					
C, %	.. 84.9	85.6	83.8	85.2	87.4
H, %	.. 14.8	12.7	10.2	14.7	12.0
O, %	.. 0.0	0.0	0.76	0.0	0.2 }
N, %	.. 0.19	0.2	0.54	0.1	0.6 }
S, %	.. 0.16	1.6	4.7	0.006	1.6 }
Grams H/100 grams C	.. 17.4	14.8	12.2	17.2	13.7
Aniline point, °C.	.. 53	46	—	46	41
Sp. gr.	.. 0.730	0.852	1.020	0.723	0.876

There is close similarity between the straight-run and the sump phase gasoline. Middle oil and heavy oil obtained by sump-phase hydrogenation have, however, a somewhat lower hydrogenation content than the straight-run oil, because only a small hydrogenating effect was obtained. This resulted from the rather high temperature and the small amount of catalyst used in this case in order to obtain a high throughput. Especially in the higher fractions, even dehydrogenation and condensation had been allowed to take place. The heavy oil produced in hydrogenation is recovered free from asphalt and differs therein from the straight-run residue. If it is not intended to convert this oil into middle oil by recycling, this asphalt-free heavy oil may be utilised more advantageously than the straight-run residue, notwithstanding the higher hydrogen content of the latter.

Thus, the character of the sources of sump phase hydrogenation products may be clearly recognised by their composition. The accompanying graph shows the relation between the hydrogen content and the boiling range (or molecular weight) and gives a bird's-eye view of the various products, their differences, and the changes they are subjected to in hydrogenation.

The hydrogenation with a rigidly arranged lump catalyst is used in large-scale operation for the production of gasoline from middle oils of various origins in the gas phase. By processing over a solid catalyst, a great number of products can be obtained by varying the starting materials and the operating conditions. On the other hand, such products can be produced as lubricating oils, illuminating oils, or Diesel oils, where a high hydrogen content is desirable; on the other hand, it is possible to produce by operation with a low hydrogenating effect, especially at elevated temperature (for example, above 500° C.), low hydrogen products of the aromatic type, such as high-octane-number gasolines and solvents.

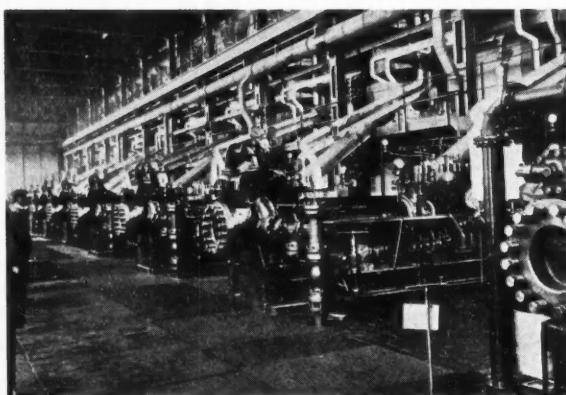


Fig. 4. Coal-Paste Presses.

The details of hydrogenation with a solid catalyst will not be given here. Its application will be illustrated by two examples from the hydrogenation of coke-oven products. Crude benzene and even the higher boiling and more unstable heavy benzenes can be hydrogen refined practically without loss:

	Heavy Benzene, Before hydrogenation.	After hydrogenation.
Ultimate analysis:		
C, %	89.6	89.9
H, %	8.4	10.0
O × N, %	1.8	0.1
S, %	0.2	0.03
Sp. gr.	0.931	0.888
Boiling range:		
Initial b. p., °C.	140	132
<170° C., %	41.0	60.0
170-200° C., %	88.0	91.0
200-220° C., %	96.0	95.0
Octane rating	—	105
Copper dish test, mg./100 cc.	>1,000	2.8

In the hydrogenation of middle oil from coke-oven tar in the presence of highly active catalysts at about 420° C. and about 200 atmospheres pressure, either gasoline alone is produced, or gasoline and a gas phase middle oil rich in hydrogen are obtained. In the first case the gasoline yield is about 90 per cent. by weight or more, in the second case about 95 per cent. by weight or more of gasoline and gas phase middle oil result:

	Gas Phase Gasoline.	Middle Oil.
Sp. gr.	0.740	0.855
Aniline point, °C.	42	40
Boiling range:		
Initial b. p., °C.	39	185
<70° C., %	12	—
70-100° C., %	38.5	—
End point, °C.	175	295
Sulphur, %	0.01	0.05
Octane rating	70	—

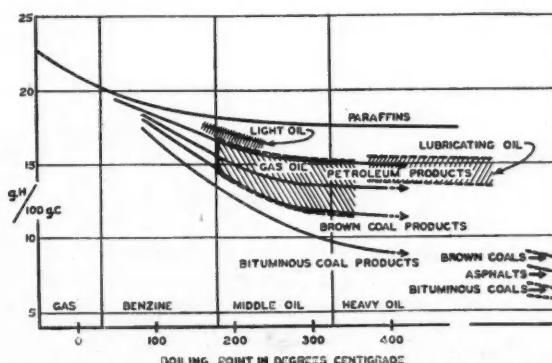


Fig. 5. Relation between Hydrogen Content and Boiling Range.

This gas phase gasoline needs no other refining treatment than an alkali wash for the removal of the dissolved hydrogen sulphide. It is practically sulphur-free and stable; the knock rating is good. The gas phase middle oil is water-white, and it can be used on account of its high hydrogen content—for example, as a good Diesel oil.

Recently it has become possible by the use of special catalysts to produce gasoline with the same yield, the octane rating of which is 5 to 10 units higher, depending upon the raw materials.

As shown by these two examples, the products of gas phase hydrogenation have in common the fact that they are excellently refined. In the case of benzene refining, no splitting occurred and very little hydrogen was taken up, with the result that the aromatic nature was largely conserved; in the second case (hydrogenation of the middle oil from low hydrogen coke-oven tar), either complete splitting into gasoline or conversion into a refined middle oil took place, both with a large degree of hydrogen saturation. With hydrogenation in the gas phase the highest yield of liquid products—that is, the lowest gas formation—is usually obtained when splitting occurs under strongly hydrogenating conditions. The production of gasoline with high knock rating and high aromatic content by using higher temperatures is associated with a higher gas loss.

When hydrogenation in the gas phase is carried out under mild conditions (catalyst, temperature, pressure, time of reaction, etc.), the products have, to a large extent, the characteristics of the starting materials. This factor is important when advantage may be gained by preserving the basic characteristics of the raw material. Here may be mentioned the aromatic structure of the crude benzene or of the gasoline from bituminous coal or, on the other hand, the more aliphatic character of Diesel and lubricating oils with high hydrogen content from lignite or petroleum oil. When using more severe conditions, however, the basic characteristics may also be changed, as far as may be desirable; for example, a Diesel oil rich in hydrogen may be produced from the middle oil

from low-hydrogen coke-oven tar, or an aromatic high-anti knock gasoline from a petroleum middle oil.

In the gas phase all oils of low or medium boiling range can be treated; similarly, many oils with a higher boiling range can be treated, using a rigidly arranged catalyst. Hydrogenation in the sump phase makes possible the production of oils suitable for treatment with a rigidly arranged catalyst when such oils are not available in nature or are not produced in other processes, from coal, tars, or asphalt-containing petroleum oils or cracking residues. The latter would be difficult to utilise otherwise. Besides the possibility of further treatment of the sump phase hydrogenation products in the gas phase, there is also the possibility of direct commercial utilisation.

A great advantage in the application of the hydrogenation process is that the principal machinery of hydrogenation plants, especially the high-pressure equipment and the hydrogen plant, can be used practically unchanged for the processing of the various raw materials and for the production of a

great variety of final products. This process of catalytic destructive hydrogenation consequently covers a wide field of application, since it can be accommodated not only to a great variety of raw materials, but also to the market situations obtaining at any time.

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Polarimeters, Saccharimeters and Refractometers Their Use in the Sugar and Jam Boiling Industries

THE earliest form of polarimeter was an arrangement of two mirrors; its immediate successor comprised a fixed Nicol prism to produce plane polarised light (the emergent extraordinary ray) and a rotatable Nicol prism to determine the direction of the plane of polarisation, said Mr. L. Eynon; of Eynon and Lane, official analysts to the Sugar Association of London, in an address on "Polarimeters, Saccharimeters and Refractometers in Sugar, Jam-Boiling, and Other Industries," read at the 2nd Conference on Industrial Physics, at Birmingham, on March 19.

The solution under investigation was placed between the two Nicols and its effect in rotating the plane of polarisation was measured by rotating the analysing Nicol until the original intensity of illumination of the field was restored. In both forms of instrument the determination of rotation depended on the judgment of the maximum brightness (or maximum darkness) of the field. The eye is, however, very much more sensitive to difference of degree of illumination of two adjacent fields and a number of devices have been proposed for obtaining this effect. The two devices most widely used to-day are the Laurent half wave plate and the Lippich polariser. The object of each device is to produce illumination of two halves of the field by beams of plane polarised light with their planes of polarisation set at an angle (the half shadow angle) to each other. The Laurent instrument can only be used with monochromatic light of wave length to which the half wave plate is suited; the Lippich polarimeter can be used with monochromatic light of any wave length.

The saccharimeter is a special form of polarimeter adapted for use with ordinary white light. Its characteristic feature is a system of quartz plate and quartz wedges, the "quartz compensator," whereby the rotation of the plane of polarisation produced by the optically active substance under examination can be compensated without any alteration of the position of the analyser which, in saccharimeters, is fixed. Quartz has almost the same rotation dispersion as the sugars and other carbohydrates and hence it is possible to use white light for illumination although, since the dispersions are not identical, the light should be partially homogenised by filtration through potassium dichromate solution or other suitable filter. There are two saccharimetric scales in use to-day, the Laurent or French scale and the Venzke or International Sugar scale. The 100° point of the Laurent scale as at present defined corresponds to the rotation of a solution of 16.29 g. of sucrose in 100 metric cc. read in a 200 mm. tube at 20° C.

The 100° point of the Venzke or International Sugar scale corresponds to the rotation of a solution of 26.00 g. of sucrose in 100 metric cc. read in a 200 mm. tube at 20° C. In tropical countries the glass parts of optical instruments are liable to attack by fungi and in some recent forms of saccharimeter the polarising and analysing Nicols and the quartz compensator can be removed from the instrument for storage under dry conditions.

There are two main types of refractometer, the Abbe and the Immersion refractometer. Both depend on the determination of the critical angle of incidence dividing refracted from reflected light at the interface of two media (glass and the substance under examination). In both types of instrument the light traverses the substance under examination; in the Abbe refractometer the stratum of substance, contained between two prisms, is thin and this instrument is specially suitable for small quantities of viscous liquids and of rather highly coloured liquids. In a more recent form of refractometer the substance is placed on the surface of a single prism and the light is refracted or totally reflected at the interface without traversing the substance under examination; this type of instrument is specially adapted for very dark or turbid liquids and since the liquid is merely placed on the surface of the prism there is no danger of the latter being damaged by solid particles such as seeds in jam. Of recent years hand or pocket refractometers have been devised for the rapid examination of beet and cane juices, etc., in the field and factory.

Refractometers are frequently calibrated in terms of sucrose content as well as refractive indices. The sucrose figures, when corrected for invert sugar or other constituents such as citric acid, serve for the accurate and rapid determination of solids in sugar syrups, jams, etc.

THE Canadian output of magnesitic-dolomite, used as refractory for furnace linings, was valued at \$722,125, a considerable increase over the preceding year. Sulphur, including sulphur in pyrites shipped from the mines, sulphur in sulphuric acid made from smelter gases, and elemental sulphur made at Trail from smelter gases, totalled 105,258 tons, worth nearly a million dollars, an increase of 56 per cent. in quantity and 46 per cent. in value over 1935. Sodium sulphate, produced only in Saskatchewan, showed a considerable increase; talc output was higher, and nepheline-syenite was produced commercially in Canada for the first time.

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Some Problems for the Food Chemist

Margarine, Chocolate and Potatoes

ONCE or twice each year members of the Food Group of the Society of Chemical Industry are invited to contribute short original papers on some general food topic which are read and discussed at a special meeting. These meetings have seldom failed to attract large audiences representing all branches of food chemistry and research, and the one held at the Institute of Chemistry on March 10 was no exception to the rule. Dr. Franklyn Kidd, chairman of the Group, presided, and three papers on widely different subjects were read and discussed.

Mr. P. N. WILLIAMS, one of the chief chemists concerned in the manufacture of Stork margarine, speaking on margarine said that product to-day occupied an important position as a national food. Although in recent years the trend of modern nutritional research had been in the direction of assessing and emphasising the value of traces of various substances present in foods, it had always to be remembered that any diet must primarily be satisfactory in total calorific value. The British Medical Association's publication, "Family Meals and Catering," left no doubt as to the food value of margarine on a calorific basis. During the last 50 years, the results of many digestibility tests had shown that margarine was digested to the extent of 96 to 99 per cent. In addition, research throughout the world had shown that both margarine and the fats used in making it were almost completely used by the body.

In a large section of the community, little or no butter was consumed, and, moreover, in the same section little milk was consumed. For instance, a quarter pint, which would yield 5 grams of butter fat, was frequently a person's daily milk consumption. Bread and margarine were a staple part of the diet, and it had been found that eight slices of bread and margarine a day—a not unreasonable amount for a working man—would lead to the consumption of 70 grams of margarine. If this margarine had a vitamin content equal to that of butter, there would be far less doubt as to the adequacy of the person's vitamin A and D consumption.

Vitaminised margarine was placed on the market for the first time 10 years ago. To-day, the great bulk of margarine—in Great Britain, at least—was adequately vitaminised in respect of vitamins A and D. There was no doubt that such margarines were a valuable source of fat-soluble vitamins A and D. The value of these margarines had been recognised by the Ministry of Health, and recommendations of them had been made in a number of official publications relating to improvements in diet.

Chocolate Fat Bloom

Dr. WILLIAM CLAYTON, chief chemist of Crosse and Blackwell, Ltd., read a paper on "Physical-Chemical Investigations Incidental to the Study of Chocolate Fat Bloom," which represented a joint contribution with Sydney Back, R. I. Johnson and J. F. Morse. It was, he explained, Part I of a series of papers on their research into this subject.

The grey film which developed on stored chocolate, the so-called fat bloom, said Dr. Clayton, was a consequence of the fractional crystallisation of the higher-melting fractions of the cacao-butter medium. Its incidence was minimised by mechanical treatment of the chocolate during its preparation which induced seeding of fat crystals and their intimate incorporation in the moving mass in the conche, the tempering apparatus and in the covering technique. Lecithin was formerly claimed as a means of greatly reducing the appearance of bloom. This view was now abandoned, but lecithin did affect the mobility of fluid chocolate and thus effected a saving in the amount of cacao-butter required.

The authors believed that conching resulted in a possible partial oxidation of cacao-butter. Their experiments dealt with the preparation of air-blown cacao-butter at 250° C.,

polymerised oxidised cacao-butter being made, α and β oleo-distearin being the probable structural units. The molecular weight of the polymerised material was in the range 1,300–1,700. Depending on the degree of oxidation and polymerisation, products were obtained with optimum effect on the mobility of chocolate or on the inhibition of fat bloom. Again, it was possible by the addition of 0.25 per cent. of such material to olive oil to prevent stearin deposition from chilled oil (2°C.) for years.

These effects were ascribed to adsorption-orientation phenomena at the two interfaces in chocolates: fat cacao particles and fat/hydrophilic particles (sugar and milk powder) and, in the olive oil, at the fat/stearin crystal interface. Striking confirmation was obtained for this theory by tests on the mobility of olive oil stearin suspended in triolein at 1.5°C.

The final contribution "Method for the Determination of the Colour of Cooked Potatoes" from Lyons laboratories was a joint paper by P. Bilham, Miss A. E. Maunsell and Dr. L. H. Lampitt. It was read by Mr. BILHAM, who said that the method of measuring the colour of cooked potatoes was devised to provide a grading system for potatoes showing a tendency to blacken on cooking.

Colour of Cooked Potatoes

A panel of judges was provided with colour-cards to aid them in judging, and were asked to give marks for freedom from greyness. They had no difficulty in matching the colour of a sample with one of a series of yellow cards, but their evidence showed that the yellow base colour of some potatoes tended to minimise the effect of any blackening. It was considered necessary therefore to have a test method having a physical basis.

The principle was based on matching the colour of the potato with one of a series of standard yellow colour cards in some form of photometer; the photometer apparatus allows the full light from sample and card to pass. Then the photometer is actuated to diminish the reflected light from the colour card until the intensities of the light reflected from sample and colour card to each side of the field in the photometer head are equal. The card matching the colour was a record of the yellowness of the sample, and the reduction of the percentage of the light reflected from this card required to equalise the intensity of the light from the sample and card was a measure of the greyness.

In order to test the reproducibility of results by the method, tests were made with white, white-grey, yellow and yellow-grey potatoes in which combinations involving a mixture of any two samples were submitted to measurement. The results obtained were compared with the theoretical figures, calculated from the results obtained from the measurement of the two original potatoes. Among all the tests carried out, no deviation from the theoretical greater than half a grade was detected.

This type of technique had, Mr. Bilham explained, been in use for many years in colorimetry for transparent liquids, but no instance had come to their knowledge of its application to measurement with reflected light. The accuracy was not high but was sufficient for the purpose, and the use of the same colour standards by the panel of judges enabled a comparison of results to be obtained.

TOTAL imports of benzol (light coal tar oils) into Germany during the first 11 months of 1936 aggregated 55,507 metric tons compared with 53,924 tons during the corresponding period of 1935. Of the 1936 eleven months imports, 49 per cent. or 27,297 tons, were shipped from the United States as against 31 per cent. or 16,897 tons, in the 1935 eleven month period.

Chemical Engineering Exhibition

Achema VIII, July, 1937

THE Achema VIII chemical engineering exhibition will be held at Frankfort-on-Main in July. Nowhere in the world does a chemical engineering exhibition having such volume and importance exist and no chemical engineering exhibition is of greater interest to science and technology. The Achema which is held every three to four years is considered in Europe and overseas to be a reflection of the productive ability and ingenuity of the German chemical plant and apparatus building industry working for scientific and engineering purposes.

The organisation and arrangement of all tours of groups of visitors to the exhibition, as also the programme for the sojourn and hotel accommodation and the organisation of conducted tours of study through Germany which are to take place after the Achema, has been entrusted by the Dechema, the organizer of the exhibition to the North German Lloyd, which acts in the capacity of official travel bureau of the Achema. The two principal programme for which arrangements have been made, are the sojourn in Frankfort-on-Main from July 1 to 6, and a trip of study through Germany from July 6 to 25 (Frankfort-on-Main, Eisenach, Magdeburg, Berlin, Dresden, Munich, Stuttgart, Heidelberg, Darmstadt, Wiesbaden, Cologne and Essen).

Tours of groups of visitors will be organised jointly by the representatives of the North German Lloyd and the competent representatives of the Achema in conjunction with the scientific and technical societies and the industrial associations of the visitors' home countries. A detailed prospectus of the Achema in English is available for distribution among members of scientific and industrial associations, and detailed programmes for the stay in Frankfort and the trip of study through Germany are available in English. For students of chemical engineering there will be courses of studies at Frankfort, from July 3 to 6. Further information can be had from the Dechema, Potsdamerstr. 103a, Berlin, W.35. After the course student visitors will be able to make a cheap tour of study through Germany, which will include visits to important chemical works.

City of Birmingham Handbook

Story of a Well Governed City

THE vast ramifications of Birmingham's local administration are described in the City of Birmingham Handbook, the 1937 edition of which has just been issued. One in every 35 of Birmingham's million population is employed in the service of the community. It must, however, be recognised that Birmingham is the birthplace of the principle of public ownership, and numbered among its public servants are the staffs of its municipally owned public service undertakings. On its water supply, which brings water from the heart of Wales, Birmingham has spent over eleven million pounds, and to-day the annual income of the undertaking is nearly one-tenth of that sum. Upon its electricity undertaking, Birmingham has expended over seventeen million pounds, while gas, the first of the public services to be publicly owned, has cost Birmingham ratepayers nearly six million pounds. The total capital raised for Birmingham's civic needs totals eighty-six million pounds, of which thirty millions have been repaid. The annual turnover of the city exceeds eighteen million pounds. Birmingham's 42,000 municipal dwellings accommodate a population equal to that of Birkenhead or Brighton. In public health, vital statistics show consistent progress, in education new schemes for technical education are proceeding; and the newest development, the Airport of Birmingham, proceeds towards completion as the finest airport in the country. During the past year, the rateable value increased by £137,406, and to-day the product of a penny rate amounts to £26,363.

In his foreword, the Lord Mayor refers to the Birmingham Hospitals Centre scheme, which is due for completion this year and has cost £1,000,000.

Sugar Technology in India

New Institute Opened

THE Imperial Institute of Sugar Technology at Cawnpore was opened by Sir Frank Noyce, the Member for Industry in the Government of India, on March 10. The starting of this Institute had been recommended by the Indian Sugar Committee, but as an interim measure a sugar section had been maintained in the Harcourt Butler Technological Institute, the whole of which has now been taken over by the Imperial Council of Agricultural Research for special work.

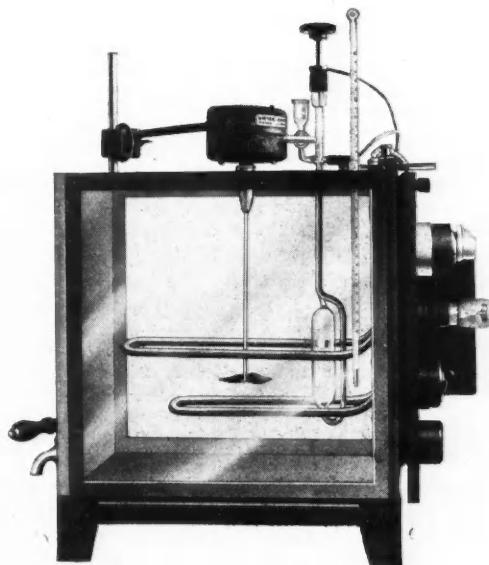
The Institute will undertake research on (1) problems of sugar technology in general, and those of sugar factories in India in particular; (2) utilisation of by-products of the industry; (3) detailed testing of new varieties of cane under factory conditions; and (4) general problems of sugar engineering and chemistry. The Institute will also provide adequate facilities for training students in all branches of sugar technology, and give short refresher courses for men already employed in the industry.

A New Thermostat Bath

Sensitive Control Outfit

THE necessity of maintaining apparatus, controlling reactions or making viscosity determinations at constant temperatures within fine limits, is increasingly required by modern laboratory technique. The Victor thermostat bath with sensitive control outfit has been designed by J. W. Towers and Co., Ltd. to meet this need. It is suitable for temperatures from 25° to 95° C. (or lower temperatures if fitted with a cooling coil) and under good conditions will maintain a constant temperature within $\pm 0.01^{\circ}$ C. over long periods without attention.

Improvements in the toluol regulator and control outfit have overcome trouble due to the fouling of mercury in the regula-



The Victor Thermostat Bath.

tor and the burning of contact points on the relay. The heating elements are two low-tag copper cased elements which can be bent to the best shape to give even heating and are controlled by a series-parallel switch. This enables the bath to be heated up rapidly on full heat, and maintained at a constant temperature with both elements in series. An induction type electric stirrer (single speed for 230-250 volts, A.C. only) is provided and gives efficient agitation without sparking.

Decreased Chemical Imports in India

Statistics for Nine Months

ACCORDING to the survey of the import trade of India during the first nine months of the fiscal year, April 1 to December 31, 1936, the total value of imports decreased, as compared with the corresponding period of 1935, by Rs. 10 crores or 10 per cent. and amounted to Rs. 90 crores, while the total exports, including re-exports, rose by Rs. 20,96 lakhs or 18 per cent. to Rs. 139 crores. The exports of Indian merchandise showed an increase of Rs. 19.97 lakhs or 17 per cent. and re-exports of Rs. 99 lakhs or 30 per cent. The grand total of imports, exports and re-exports amounted to Rs. 229 crores, an increase of Rs. 11 crores or 5 per cent.

The long period of steady expansion in the imports of Chemicals appears to have come to an end and there was a heavy fall recorded during the period under review, from Rs. 232 lakhs to Rs. 183½ lakhs. Details of countries of origin are not available in respect of the following items, the total imports of which were as follows:—

	<i>Nine Months Ended December 31.</i>	
	<i>1935.</i>	<i>1936.</i>
	<i>Rs. (lakhs).</i>	<i>Rs. (lakhs).</i>
Acids	9	5½
Bleaching powder	9½	6½
Carbide of calcium	5½	5
Copper sulphate	3	1½
Disinfectants	4½	4½
Glycerine	3	½
Potassium chlorate	8	4
Sodium bicarbonate	6	3½
Sodium bichromate	2½	2½
Sulphur	15½	15½

The total trade in sodium carbonate fell heavily from Rs. 43 lakhs to Rs. 33½ lakhs, the United Kingdom share being reduced from Rs. 36½ lakhs to Rs. 28½ lakhs and that of "other countries" also fell from 6½ lakhs to Rs. 5 lakhs. In the case of caustic soda a heavy fall in the total trade was registered from Rs. 31½ lakhs to Rs. 25½ lakhs, the whole of which was borne by the United Kingdom. Arrivals from that country declined from Rs. 27½ lakhs to Rs. 20½ lakhs.

Drugs and Medicines

The total trade in drugs and medicines showed a decline from Rs. 157½ to Rs. 147½ lakhs, but imports of proprietary and patent medicines increased from Rs. 48½ lakhs to Rs. 40½ lakhs. Of this amount the United Kingdom supplied Rs. 21½ lakhs as against Rs. 20½ lakhs in the corresponding period of the preceding year. The German share also increased from Rs. 11½ lakhs to Rs. 12½ lakhs, whilst that of the United States remained stationary at Rs. 8½ lakhs to Rs. 6½ lakhs. Imports of quinine salts were reduced considerably from Rs. 21 lakhs to Rs. 15½ lakhs, due almost entirely to a fall in shipments from Germany from Rs. 8½ lakhs to Rs. 4½ lakhs. The United Kingdom proportion was steady at Rs. 6½ lakhs, whilst that of Java rose from Rs. 2 lakhs to Rs. 2½ lakhs. The share of "other countries" declined from Rs. 4½ lakhs to Rs. 3 lakhs.

The total imports of dyes obtained from coal tar fell from 14,093,554 lb. valued at Rs. 215½ lakhs to 11,635,008 lb. valued at Rs. 170½ lakhs, the principal sufferer being Germany whose sendings were reduced from 9,432,057 lb. (Rs. 140½ lakhs) to 7,966,505 lb. (Rs. 115½ lakhs). Imports from the United Kingdom also decreased from 1,607,518 lb. (Rs. 30½ lakhs) to 1,185,350 lbs. (Rs. 24½ lakhs). A reduction was also recorded in arrivals from Switzerland from 574,224 lbs. (Rs. 16½ lakhs) to 267,293 lb. (Rs. 9½ lakhs). Imports from Japan were reduced from 861,590 lb. (Rs. 8 lakhs) to 797,306 lb. (Rs. 7½ lakhs) and from the United States from 935,238 lbs. (Rs. 8½ lakhs) to 662,339 lbs. (Rs. 6½ lakhs).

*Rupees one lakh (Rs. 1,00,000) = £7,500 at 1s. 6d. exchange.
Rupees one crore = Rs. 100 lakhs = £750,000.

The aggregate paint and colour trade shows a fall from 267,343 cwt. valued at Rs. 58½ lakhs to 275,393 cwt. valued at Rs. 54 lakhs. The share of the United Kingdom declined from 135,788 cwt. (Rs. 37½ lakhs) to 114,405 cwt. (Rs. 33½ lakhs), that of Germany increased in quantity from 19,447 cwt. to 22,800 cwt., but decreased in value from Rs. 5½ lakhs to Rs. 4½ lakhs. Sendings from the United States rose from 5,959 cwt. (Rs. 2½ lakhs) to 7,469 cwt. (Rs. 3 lakhs) and those from Japan while showing a reduction in quantity from 41,949 cwt. to 38,902 cwt. remained practically the same in value at Rs. 7 lakhs. Arrivals from "other countries" increased from 64,200 cwt. to 91,817 cwt., but fell in value from Rs. 6½ lakhs to Rs. 5½ lakhs.

The rapid expansion of local soap manufacture has reduced the imports of soap to a fraction of their former value, and during the nine months under review the trade showed a further decline from Rs. 26 lakhs in the first nine months of 1935-6 to Rs. 20½ lakhs in the same period of the current year.

Chemistry of Building Materials

Present-Day Problems

THE knowledge which the architect and builder possess relative to the chemical characteristics of their materials is limited, and it has to be recognised that the chemical problems of the industry have come upon them very suddenly and found them rather unprepared, said Mr. F. L. Brady, M.Sc., A.I.C., in a paper on "Chemistry in the Building Industry," read before the London and South Eastern Counties Section of the Institute of Chemistry, on March 17.

Until about one hundred years ago, the materials used in building were few in number—bricks, lime, sand, natural stones, lead and timber. These materials are not chemically simple, but the building craft, as a result of many generations of trial and error has discovered how best to use them, avoiding their characteristic difficulties and exploiting their natural advantages. To-day the position is changed. New materials, with valuable properties not found in the traditional materials, were introduced. First came Portland cement, a complex binding agent, whose true nature we are only just beginning to understand. Then came new and improved plasters, new types of paints, magnesium oxychloride cement, and sand-lime bricks.

Magnesium oxychloride cement is extraordinarily strong and has the unique property that it can be loaded with large quantities of fillers such as sawdust and wood flour, amounting to several times its own volume. Portland cement would be much less suitable for use in this way. This adaptability can be exploited in various ways. By using a high proportion of fibrous organic fillers a soft resilient base can be made which can be finished with a denser, hard wearing surface, so producing a warm, comfortable and durable floor. As the material is laid in a plastic condition it can be used in large uninterrupted areas and worked as a coved skirting to walls, a matter of some importance in hospitals and similar buildings. Difficulty could arise, however, if an excess of absorptive filler was used, since this involved the introduction of an excess of magnesium chloride and such floors tended to be damp or, as builders describe it, to "sweat." Magnesium oxychloride floors needed protection by oiling or waxing to protect them against humidity and against decomposition of the oxychloride compound by atmospheric carbon dioxide.

A type of injury which sometimes occurs with cement renderings on brickwork was ascribed to the action of sulphates derived from bricks. Interaction with the cement in the renderings leads to the formation of calcium sulphoaluminate (the cement "bacillus") and the resulting expansion causes the partial detachment of the rendering.

New Technical Books

INTERMEDIATE CHEMISTRY. By T. M. Lowry and A. C. Cavell. London : Macmillan & Co., Ltd. Pp. 876. 12s. 6d.

The purpose of this book is to provide a complete text-book of chemistry for Intermediate and Higher School Certificate examinations. It includes sections on general and theoretical, inorganic and organic, analytical and physical chemistry. The inorganic section (Parts I to III) has been completely reconstructed, and bears only a remote resemblance to Lowry's "Inorganic Chemistry." The four chapters on inorganic analysis (Part IV) and the whole of the section on "Principles of Organic Chemistry" (Part VI), with the exception of some of the organic preparations, are new. Only the physical section (Part V) resembles at all closely those portions of Lowry and Sugden's "Class-book of Physical Chemistry" which have been adapted with relatively little change for their present use. The organic section, under the title "Principles of Organic Chemistry," includes the subjects prescribed in the new syllabus recently issued by the University of London. Experiments numbered from 1 to 190 are an important feature of the book. They have survived the test of use in school classes, and it is believed that they will be of real value in practical work. They include a series of preparations, which are attached to those paragraphs to which they are most closely related; but tables for use in qualitative analysis, and detailed instructions for volumetric and gravimetric analysis, have been placed together in Part IV of the book. Since the book is intended to be used in the laboratory as well as in the classroom, it has been provided with a water-proofed cover. Typical questions have been collected and classified into sections corresponding to successive groups of chapters, so that the reader may be able to test his progress in knowledge at convenient stages.

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SEMI-MICRO QUALITATIVE ANALYSIS. By Carl J. Engelder, Tobias H. Dunkelberger and William J. Schiller. New York : Wiley & Sons, Inc. London : Chapman & Hall, Ltd. Pp. 265. 13s. 6d.

Microchemistry has advanced with remarkable strides during the past several decades. This is particularly true of the methods and technique of quantitative microanalysis and of chemical microscopy. In the field of qualitative analysis, aside from the great improvements in the methods of microscopic separation and identification, there has been developed a special technique, the "drop-reaction" method—semi-micro in scale—in which the operations of qualitative analysis are conducted on a reduced scale and in which the microscope is not employed. About eight years ago, the authors, impressed by the advantages of this "drop" technique for instructional purposes in qualitative analysis, began a study of these new methods. Eventually a systematic scheme based on existing macro schemes was evolved. The procedures and methods worked out in the present book can be employed by beginning students and require no previous special training. Flexibility of the material has been sought so that the book might serve the needs of the professional analyst as well as the student. The analyst will find among the new reactions described many shorter and more delicate tests than are possible with the older methods. The more important advances among the large mass of new material appearing in the recent chemical literature have been included. Only those tests which the authors have tried and found successful have been described in detail.

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CHEMICAL PRINCIPLES: WITH PARTICULAR APPLICATION TO QUALITATIVE ANALYSIS. By John H. Yeo. New York : John Wiley and Sons, Inc. London : Chapman and Hall, Ltd. Pp. 311. 13s. 6d.

By reading this book the student will have an opportunity to develop his technique in carrying out not-too-complicated chemical operations and to study at first hand many of the fundamental principles of chemistry. Such a course should

serve the dual purpose of reviewing and expanding the student's knowledge of general chemistry and of preparing him for more advanced courses, especially physical or theoretical chemistry. The first four chapters are intended to furnish a brief review of certain ideas and fundamental laws treated in general chemistry, and they have purposely been made elementary and concise. The chapters which follow are devoted to gases, liquids, solids, solutions and electrolytes, and a study of chemical equilibrium (homogeneous and heterogeneous). Applications of the law of chemical equilibrium to the various types of equilibria encountered in qualitative analysis are also considered. Illustrative problems are solved for each type of equilibrium, and many additional problems are given (with answers) for home and class work. On account of the importance of the hydrogen-ion concentration, not only in chemistry, but also in the biological and medical sciences, this subject is treated in considerable detail. Colloids form the subject for the concluding chapter. In view of the importance of this subject, not only to students who are going on with chemistry, but also to those who plan to go into biology, medicine, and other sciences, this has been made relatively detailed, and should give the student a clear understanding and appreciation of matter in the colloid state and of the importance of colloid chemistry from theoretical and practical standpoints.

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STRUCTURE AND MOLECULAR FORCES IN (a) PURE LIQUIDS AND (b) SOLUTIONS. A General Discussion reprinted from the "Transactions of the Faraday Society." London : Gurney and Jackson. Pp. 282. 12s. 6d.

This general discussion on the structure and molecular forces in pure liquids and solutions provided the Faraday Society with an excellent opportunity to enlighten chemists upon the tremendous changes which have taken place in recent years with regard to our fundamental conceptions in this field. The hard-and-fast distinction between the solid, liquid and gaseous states—to which the liquid-vapour critical point formerly supplied the only exception—has now largely disappeared. The transition from the liquid to the solid state proves to be by no means so sudden as the "simple" phenomenon of freezing has led us to postulate, and adsorption experiments have indicated definite intermediate steps even between crystals and gases. In spite of this merging of the three states of matter towards one theoretical continuity, nevertheless, it is certain that for many practical considerations the perpetuation of the distinction between them will remain. That the forces between "liquid" and "gaseous" molecules influence their behaviour in quite diverse ways may be seen by examining briefly one particular physical property—viscosity. The viscosity of a liquid decreases as the temperature is raised; the viscosity of a gas increases. The viscosity of a liquid increases with pressure; the viscosity of a gas is unaffected by pressure. In every respect the two states of matter show fundamental differences, and, although the theory of gaseous viscosity was worked out in 1860 by Clerk Maxwell, we are only now beginning to understand the more complicated case of liquids.

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QUANTITATIVE ANALYSIS. By William Rieman and Jacob D. Neuss. London : McGraw-Hill Publishing Co., Ltd. Pp. 425. 18s.

There has been a marked tendency in the last decade to reject rule-of-thumb methods of teaching quantitative analysis and to explain the analytical procedures in the light of physical chemistry. This book is offered as another step in the trend toward the theoretical aspects of quantitative analysis. Every theoretical discussion in the text is located immediately before or immediately after the laboratory procedure to which it applies. Perhaps the most important innovation is the early introduction of the theory and technique of potentiometric measurements. Not many years ago this subject was not to be found in the textbooks on quantitative

analysis; now it appears near the end of most books. In the book under review the subject is introduced in connection with the first analysis, the volumetric determination of chloride, and is used thereafter to explain the procedures of acidimetry, alkimetry, oxidimetry, electrolysis, and measurement of pH . According to the authors, this early introduction of potentiometric measurements has been practised for several years with gratifying results. An entire chapter is devoted to the phenomenon of co-precipitation. The calculations dealing with solubility products, electrode potentials, and ionisation constants are simplified by the use of the classical laws (concentrations rather than activities) and the assumption that strong electrolytes are completely ionised. Each chapter is supplemented by a generous number of problems. The problems cannot be answered by merely reading and copying the appropriate portions of the text; they require independent thought or calculations, or both.

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THE DISPENSATORY OF THE UNITED STATES OF AMERICA.—Centennial (22nd) Edition. By H. C. Wood, C. H. LaWall, H. W. Youngken, A. Osol, I. Griffith and L. Gershenfeld. Philadelphia and London: J. B. Lippincott Co. Pp. 1894. 65s.

It is rare indeed that a book on a scientific subject survives and continues in use for over a hundred years. The first

edition of the United States Dispensatory appeared in 1833: since that day it has enjoyed an ever increasing popularity, and its reputation has extended until there is scarcely a civilised country where the book is unknown. Throughout the hundred years of its existence the main purpose and general plan of the book have remained unchanged. It continues, as it has always been, primarily a commentary on the United States Pharmacopoeia, but also recognises the authority of the British Pharmacopoeia and of the National Formulary, and has become an encyclopaedia of unofficial medicaments. During the past decade there has appeared new revisions of these three official standards. All the changes which have been made in them are reported in the present volume. In Part II, covering the unofficial drugs, an attempt has been made to describe every chemical individual sold as a medicine in the United States. The dispensatory has never deemed it necessary to comment on proprietary mixtures or pharmaceutical preparations, but only on those proprietary drugs which have some claim to chemical novelty. To Part III, in which are quoted the matters considered in the United States Pharmacopoeia under the title of "General Tests, Processes and Apparatus," there have been added the formulae of the most important diagnostic reagents which are used in the clinical laboratory. The editors have exerted themselves to present the most recent information concerning the subjects treated.

Chemical Notes from Foreign Sources

Australia

CHEMICAL AND PHARMACEUTICAL PRODUCTS are to be manufactured by Itaglio Proprietary, Ltd., which has recently been registered in Sydney with a capital of £20,000.

Holland

ARTIFICIAL WOOL FROM CASEIN is being produced on an experimental scale at Arnheim by the Aku concern, who intend to continue the tests on a larger scale.

FOLLOWING FAVOURABLE RESULTS in the experimental growth of peppermint at Ter Haar in Southern Holland, a considerable increase in the acreage under cultivation is now planned.

United States

CHLORINE is to be manufactured by the Mathieson Alkali Works, either in Louisiana or Virginia. The expansion of the cellulose industry for the production of bleached Kraft paper and of rayon, has greatly increased the demand for bleaching agents.

Hungary

THE METALLOCHEMIA METALLURGICAL WORKS is now producing sulphur at the annual rate of 2,500 tons.

CASEIN ARTIFICIAL WOOL PRODUCTION is to be undertaken in Hungary by the Hungaria Artificial Fertiliser Co. under licence from the Aussig Verein of Czechoslovakia.

CARBON BISULPHIDE on a scale sufficient to meet the home demand both in the agricultural and industrial field is now being produced by a factory in Pet. Following re-organisation at the State mines at Recsk the pyrites deposits of which are being exploited by the Metallochemia Co., the factory will now have available a supply of domestic sulphur instead of being dependent upon the imported material.

Italy

THE DAILY PRODUCTION OF CASEIN ARTIFICIAL WOOL (lanital) has increased from 2 tons to 5 tons and a further increase is planned for the coming year.

CALCIUM CARBIDE IS NOW PRODUCED in Italy on the scale of about 200,000 tons per annum. About 30,000 tons are used for acetylene production and 10 to 15,000 tons as starting material for the production of synthetic chemicals.

Germany

PLANS FOR THE PRODUCTION OF CASEIN on a considerable scale are being pushed forward in East Prussia.

Poland

THE PRODUCTION OF GLAUBER SALTS has been commenced by the Silesia Zinc Metallurgical Works, of Lipine.

EXTENSIVE AMBER DEPOSITS have been discovered in the Teresia Coal Mines at Gostytozyn. Some of the lumps weigh as much as 1 lb.

Japan

UREA PRODUCTION IS ABOUT TO COMMENCE at the new factory of Sumitomo Kagaku K.K. and the product will be on the market in June.

PLANS FOR THE FORMATION OF A COMPANY to manufacture pure alcohol have been approved by the Togo Takushoku K.K. (Development Company for Far East).

THE COAL HYDROGENATION PROJECTS now being developed should result after 7 years, according to a statement of the Ministry of Commerce, in an annual production of 1 million tons of petrol and heavy oil.

EXPERIMENTS ON THE CLEANING OF RICE with acetone which have been made by the Chosen Chisso Hiryo K.K. have given encouraging results, the rice obtained being superior in quality to that cleaned by other methods.

Russia

THE FIRST RUSSIAN PLANT for production of acetic acid from acetylene has now commenced operation.

A NEW PROCESS FOR THE PRODUCTION OF VULCANITE is reported to have been developed at the Krassny Trengolnick factory in collaboration with the Research Institute of the Rubber Industry. Vulcanisation only takes 20 minutes instead of 1 to 2 hours, and the new material is said to allow of production of high-resistance accumulator cases.

BENZENE OF EXTREMELY HIGH PURITY has been prepared by M. Wojciechowski by 3 different methods: fractional distillation in Svetoslavski's apparatus, fractional crystallisation, and azeotropic distillation with alcohol which is finally removed by washing with water. The constants of pure benzene are given as: boiling point 90.093°C., freezing point 5.51°C., density at 25°C. 0.8737.

From Week to Week

BORING FOR OIL WILL BE STARTED by the D'Arcy Exploration Co., near Kingsclere, Hants, in May. The cost of the boring is estimated to be about £40,000 and the drill will penetrate for about 3,500 ft.

KEIGHLEY CORPORATION GAS COMMITTEE have considered proposals submitted by the Gas Engineer for the reconstruction of the gas works, and for augmenting the pressure of gas in the district.

A NEW DEPARTMENT of chemical engineering is shortly to be opened at Loughborough College. The new department is being run in close co-operation with the Institution of Chemical Engineers, and under the direction of Dr. G. M. Dyson, who is at the head of pure and applied science at the college.

FIRE DESTROYED many hundreds of pounds' worth of boxes and packing materials, broke out in the Fifeshire stores of John Haig and Co., whisky distillers, early on November 28. Thousands of gallons of whisky in a bonded warehouse nearby were saved by the efforts of the Kirkcaldy and Buckhaven fire brigades.

BARRS CHEMICAL CO. have removed from 93 Pitt Street, to 211 St. Vincent Street, Glasgow, C.2. This change is necessitated by their office having been affected by piling operations on the site of a new telephone exchange which is being erected beside them. Mr. Dugans, manager of the company, is the Scottish agent for Aerostyle, Ltd.

AN EXTRAORDINARY GENERAL MEETING of United Water Softeners is to be called on April 13 to consider resolutions that each ordinary share of £1 be sub-divided into four shares of 5s. each, and that the articles of association be amended. The issued capital of the company consists of 100,000 £1 ordinary shares and £32,750 in 8 per cent. cumulative preference shares of £1 each.

THE SOCIETY OF CHEMICAL INDUSTRY, American Section, will hold a meeting on April 9, at the Chemists' Club, New York, jointly with the American Chemical Society. Mr. James G. Vail will preside. The speaker will be Professor James E. Kendall, head of the department of chemistry of the University of Edinburgh, who will be in America on a tour at that time. His subject will be "Liquids and Solutions," a field in which much has been done, but which is open to many future possibilities.

IMPERIAL CHEMICAL INDUSTRIES, LTD., announces that, so far as practicable, all employees will be given a day's holiday on Wednesday, May 12. Under the company's existing agreements with the trades unions, this day will be paid for at normal rates to those not working, while those who are required to work will be paid overtime at the agreed rates. In addition, the company will present a gift of 10s. to every employee (staff and workers) who is on the pay-roll of its various offices and factories throughout the United Kingdom on May 12.

THIRTEEN MEMBERS of the London Fire Brigade were injured—three of them so seriously that they had to be kept in hospital—at a fire which occurred on March 25, at Hedley Vicars Cold Air Storage Works, in St. John's Square, Clerkenwell. Before the fire broke out there had been a serious leak of ammonia, and after the firemen entered the building there were two explosions. The men, who were wearing gas masks, were thrown against the door by the force of the second explosion. The men detained in hospital were found to have injuries on the hands and were suffering from the effects of ammonia fumes.

THE COST OF DRUGS supplied to insured persons on doctors' prescriptions under National Health Insurance in 1936 was £2,242,519, according to a statement published by the Ministry of Health. This represents an average payment of 3s. 2.3d. in respect of every insured person entitled to obtain medicines from insurance chemists. In 1935 the cost of drugs supplied to insured persons was £2,100,167, representing 3s. 1d. an insured person. As in previous years, the average consumption of medicine a head of the insured population was much higher in England and Wales than in Scotland. In Scotland the cost of drugs supplied to insured persons on doctors' prescriptions in 1936 was £176,996, or 1s. 11.3d. a patient.

THE ORGANISATION OF CHEMISTS and other scientific experts to act as gas detectors in the event of an enemy air raid, which is being set up in London, Liverpool, and Birmingham by the Air Raid Precautions Department of the Home Office, will shortly be extended to other parts of the country. The authorities think that pharmacists in shops will be of the greatest service in their own establishments during emergencies caused by air raids, as most people rely on the pharmacist in case of minor injury, or when in need of advice. They are, therefore, being encouraged to volunteer for anti-gas training, but not to act as gas detection officers, whose duty will be to patrol districts affected by air raids. Doctors are being trained at the rate of 2,000 a month for air raid duties, and nurses and medical students in all parts of the country are also receiving training.

AN ENGLISH EDITION of "Colloid Systems," by Dr. A. Von Buzagh is shortly to be published by the Technical Press, Ltd. Originally published in Dresden by Theodore Steinkoff, the book has been translated by Mr. O. B. Darbshire in collaboration with Mr. William Clayton.

CHAS. H. WINDSCHUEGL, of 1 Leadenhall Street, London, E.C.3, importer and exporter of chemicals, oils, waxes and drugs, is converting his business, which he established in 1890, into a private limited liability company, as from April 1, 1937. The business will be carried on as Chas. H. Windschuegl, Ltd. There will be no alteration in the personnel. Mr. A. E. Johnson, who for many years has been manager, will become a director.

Personal Notes

MR. CHARLES F. POOLE, of Sandbach, Cheshire, formerly a director of Brunner, Mond and Co., Ltd., now merged in Imperial Chemical Industries, Ltd., and at one time a director of Buxton Lime Firms, who died aged 73, left estate of the gross value of £36,945, with net personality £32,521.

MR. W. H. BENNETT is resigning his office as managing director of the East Surrey Gas Co., owing to pressure of work involved by his connection with Associated Gas and Water Undertakings, Ltd., and his other interests. He will continue, however, as deputy chairman of the company, and will act in a consultative capacity.

DR. HAROLD S. OLCOOT, research associate in the State University of Iowa, has been chosen by a committee of the American Chemical Society to receive the second Eli Lilly and Co. award in biological chemistry, carrying \$1,000 in cash and a bronze medal. Dr. Oleott will receive the prize at the opening session of the Society's ninety-third meeting at the University of North Carolina on April 12.

MR. J. R. W. ALEXANDER has resigned the secretaryship of the Institution of Gas Engineers on his appointment, with effect on June 21, as general manager of Associated Gas and Water Undertakings, Ltd., and as general manager of the East Surrey Gas Co. He was appointed secretary of the Institution, from 650 candidates, in 1929, in which year the Institution, founded in 1863, was granted a royal charter. Mr. Alexander was especially charged with the reorganisation and extension of the work of the Institution and has taken a prominent part in the increasing activities of the British gas industry. He was a founder and is a member of the council of the International Gas Union, and he organised and raised over £10,500 for the Sir Arthur Duckham memorial fund. He



was appointed hon. secretary of the British Gas Federation which was founded in 1934.

Books Received

The Drama of Chemistry. By Sidney J. French. New York: The University Society. London: Chapman and Hall, Ltd. Pp. 170. 4s. 6d.

"AnalalR" Standards for Laboratory Chemicals. Second Edition. London: The British Drug Houses, Ltd., and Hopkin and Williams, Ltd. Pp. 296.

Chemicals in War. By Augustin M. Prentiss. With chapters on the Protection of Civil Populations and International Situation, by George J. B. Fisher. London: McGraw-Hill Publishing Co., Ltd. Pp. 739. 45s.

Inventions in the Chemical Industry

THE following information is prepared from the Official Patents Journal. Printed copies of Specifications accepted may be obtained from the Patent Office, 25 Southampton Buildings, London, W.C.2, at 1s. each. The numbers given under "Applications for Patents" are for reference in all correspondence up to the acceptance of the Complete Specification.

Specifications Open to Public Inspection

PROCESS FOR THE MANUFACTURE AND USE OF LIQUID SELF-HARDENING GLAZES derived from synthetic resins.—H. Plauson. Sept. 11, 1935. 7786/36.

PROCESS FOR THE MANUFACTURE OF STABLE CALCIUM THIOSULPHATE and solutions thereof.—Schering-Kahlbaum A.-G. Sept. 14, 1935. 23581/36.

MANUFACTURE OF MIXED CARBIDES and of articles made therefrom.—Keramet Ges. Sept. 10, 1935. 24733/36.

INDIGOID DYESTUFFS.—Imperial Chemical Industries, Ltd. 24845/36.

RUBBER SOLUTIONS AND CEMENTS.—E. I. du Pont de Nemours and Co. Sept. 11, 1935. 24847/36.

MANUFACTURE OF CONDENSATION PRODUCTS.—I. G. Farbenindustrie. Sept. 14, 1935. 25010/36.

Specifications Accepted with Date of Application

MANUFACTURE OF CELLULOSE DERIVATIVES, and of artificial filaments, films, and other shaped structures therefrom.—Dr. L. Lilienfeld. May 29, 1935. 462,456.

MANUFACTURE OF CELLULOSE DERIVATIVES, and of artificial filaments, films, and other shaped structures therefrom.—Dr. L. Lilienfeld. June 11, 1935. 462,713.

PROCESS FOR THE MANUFACTURE OF ARTICLES RESISTANT TO GASEOUS CORROSION.—Soc. D'Electro-Chimie, D'Electro-Metallurgie, et des Acieries Electriques D'Ugine. June 2, 1935. 462,380.

CHEMICAL PROCESSES IN THE GASEOUS OR VAPOROUS PHASE.—H. Dreyfus. June 12, 1935. 462,714.

PRODUCTION OF MORPHOLINE VINYL ETHERS and N-bio morpholinium halides.—Carbide and Carbon Chemicals Corporation. July 19, 1934. 462,383.

DYESTUFF PREPARATIONS AND PRINTING PASTES.—W. W. Groves (I. G. Farbenindustrie). June 28, 1935. 462,384.

MANUFACTURE OF CONDENSATION PRODUCTS of the anthraquinone series.—A. Carpmael (I. G. Farbenindustrie). July 2, 1935. 462,386.

MANUFACTURE AND PRODUCTION OF AZO DYESTUFFS.—Coutts and Co., and F. Johnson (legal representatives of J. Y. Johnson (deceased)) (I. G. Farbenindustrie). July 9, 1935. 462,715.

MANUFACTURE AND PRODUCTION OF TRIHYDROXYDIBENZANTHRONES and their quinones.—G. W. Johnson (I. G. Farbenindustrie). Aug. 6, 1935. 462,658.

MANUFACTURE AND PRODUCTION OF VAT DYESTUFFS of the dibenzanthrone series.—G. W. Johnson (I. G. Farbenindustrie). Aug. 6, 1935. 462,659.

STABILISATION OF MOTOR FUELS.—E. I. du Pont de Nemours and Co. Aug. 8, 1934. 462,593.

MANUFACTURE OF 2:6-DIMETHYLNAPHTHALENE-8-SULPHONIC ACID.—W. W. Groves (I. G. Farbenindustrie). Sept. 7, 1935. 462,664.

MANUFACTURE OF AZO DYESTUFFS INSOLUBLE IN WATER.—W. W. Groves (I. G. Farbenindustrie). Sept. 7, 1935. 462,535.

METHOD FOR THE CONVERSION OF OILS, FATS, AND FATTY ACIDS into elaidic acid or derivatives thereof.—Naamlooze Venootschap Nederlandsche Research Centrale. Sept. 7, 1934. 462,665.

MANUFACTURE OF WATER SOLUBLE AZO DYESTUFFS.—W. W. Groves (I. G. Farbenindustrie). Sept. 9, 1935. 462,719.

MANUFACTURE OF METHYL-AMINONAPHTHALENE-SULPHONIC ACIDS.—W. W. Groves (I. G. Farbenindustrie). Sept. 9, 1935. 462,465.

PROCESS FOR PRESERVING WOOD.—G. F. Rayner (Osmose Holzimprägning Ges.). Sept. 9, 1935. 462,597.

MANUFACTURE OF QUATERNARY AMMONIUM COMPOUNDS.—W. W. Groves (I. G. Farbenindustrie). Sept. 10, 1935. 462,720.

MANUFACTURE OF DYESTUFFS OF THE INDANTHRENE SERIES.—E. I. du Pont de Nemours and Co. Sept. 10, 1934. 462,548.

MANUFACTURE OF LEAD PIGMENTS.—Dupont Viscoloid Co. and P. D. Brossman. Sept. 10, 1935. 462,549.

MANUFACTURE OF AZO DYESTUFFS insoluble in water.—I. G. Farbenindustrie. Sept. 11, 1934. 462,601.

MANUFACTURE OF WATER-INSOLUBLE AZO DYESTUFFS.—I. G. Farbenindustrie. Sept. 12, 1934. 462,674.

PROCESS FOR THE MANUFACTURE OF TETRAKISAZO DYESTUFFS containing copper. A. Carpmael (I. G. Farbenindustrie). Sept. 11, 1935. 462,675.

MANUFACTURE OF SULPHONIC ACIDS of 5-hydroxy-acenaphthene.—W. W. Groves (I. G. Farbenindustrie). Sept. 12, 1935. 462,681.

MANUFACTURE OF NAPHTHALENE DERIVATIVES.—W. W. Groves (I. G. Farbenindustrie). Sept. 12, 1935. 462,468.

MANUFACTURE OF COPPER-CONTAINING MONOAZO DYESTUFFS.—F. L. Rose, and Imperial Chemical Industries, Ltd. Sept. 13, 1935. 462,690.

BLASTING-DEVICES.—J. Taylor, and Imperial Chemical Industries, Ltd. Sept. 13, 1935. 462,691.

MANUFACTURE OF POLISHING WAX COMPOSITIONS.—E. I. du Pont de Nemours and Co. Oct. 17, 1934. 462,692.

PROCESS FOR THE MANUFACTURE OF ACID WOOL DYESTUFFS of the anthraquinone series.—I. G. Farbenindustrie. Sept. 14, 1934. 462,693.

PROCESS FOR THE MANUFACTURE OF ACID WOOL DYESTUFFS of the anthraquinone series.—I. G. Farbenindustrie. Sept. 14, 1934. 462,694.

HEAT-EXCHANGERS FOR FLUIDS.—United Water Softeners, Ltd. Sept. 21, 1934. 462,695.

MANUFACTURE OF 6-AMINO-2-HYDROXYNAPHTHALENE-3-CARBOXYLIC ACID.—W. W. Groves (I. G. Farbenindustrie). Sept. 14, 1935. 462,699.

PROCESS OF PREPARING SILVER HALIDE EMULSIONS for the production of direct positives.—G. Szasz. Sept. 15, 1934. 462,730.

PRODUCTION OF NON-SPLINTERING LAMINATED GLASS.—A. Kampfer. Nov. 13, 1934. 462,734.

LUBRICATING-COMPOSITIONS.—Celluloid Corporation. Oct. 2, 1934. 462,556.

RECOVERY OF ISOBUTYLENE from hydrocarbon mixtures containing the same.—I. G. Farbenindustrie. Oct. 3, 1934. 462,558.

PROCESS FOR OBTAINING EXTRACTS FROM COAL AND PEAT.—M. Stinnes Gewerkschaft. March 9, 1935. 462,478.

RUBBER DERIVATIVES.—Rubber Producers' Research Association, H. P. Stevens and F. J. W. Popham. Oct. 17, 1935. 462,613.

MANUFACTURE OF BLACK SULPHUR DYESTUFFS.—A. Carpmael (I. G. Farbenindustrie). Nov. 6, 1935. 462,561.

MANUFACTURE OF OLEFINE OXIDES.—Distillers Co., Ltd., H. Langwell, C. B. Maddocks, and J. F. Short. Nov. 22, 1935. 462,487.

MANUFACTURE OF POLYOXY-CARBOXYLIC ACIDS or their salts.—A. G. Bloxam (M. Finkelstein). Nov. 30, 1935. 462,565.

OXIDATION PRODUCTS OF RUBBER.—Rubber Producers' Research Association, H. P. Stevens, and F. J. W. Popham. Dec. 24, 1935. 462,627.

SUBSTITUTED BARBITURIC ACIDS.—F. Boedecker, H. Gruber, and J. D. Riedel-e De Haen, A.-G. Jan. 24, 1936. 462,573.

MANUFACTURE OF DYESTUFFS.—Soc. of Chemical Industry in Basle. Feb. 28, 1935. 462,629.

PRODUCTION OF SUBSTANCES IN THE COLLOIDAL STATE.—J. Aumarechal. March 2, 1935. 462,494.

HYDRATION OF OLEFINES.—Usines de Melle. March 22, 1935. 462,576.

PROCESS OF REFINING HYDROCARBON OILS.—Naamlooze Venootschap de Bataafsche Petroleum Maatschappij. March 20, 1935. 462,630.

MANUFACTURE OF ALKALI METAL SALTS.—A. E. A. S. Cornelius. May 1, 1935. 462,632.

PREPARATION OF GLYCOLS from oxides of olefines.—Soc. Carbochimique Soc. Anon., P. Ferrero, C. Vandendries, and F. Berbe. May 19, 1936. 462,581.

APPARATUS FOR CONTINUOUS DISTILLATION AND RECTIFICATION OF MUSTS containing acetone, ethyl alcohol, and butyl alcohol.—Soc. des Etablissements Barbet. June 13, 1935. 462,433.

APPARATUS FOR CARRYING OUT THE SYNTHESIS OF RESINS from glycerol and phthalic acid.—W. H. Peters. June 30, 1936. 462,511.

CARBOXYLIC ACID AMIDES DERIVED FROM AZA COMPOUNDS.—Coutts and Co., and F. Johnson (Legal representatives of J. Y. Johnson (deceased)). (I. G. Farbenindustrie). June 11, 1935. 462,650.

Applications for Patents

(March 11 to 17 inclusive.)

MANUFACTURE, ETC., OF ACRYLIC ACID ESTERS AND POLYMERISATION PRODUCTS THEREOF.—Röhm & Haas, A.-G. (United States, March 7, '36.) 6801.

MANUFACTURE OF DIAZO PREPARATIONS.—Soc. of Chémical Industry in Basle. 6894, 6895.

PRODUCING COLOUR DISCHARGES ON DYED GOODS.—Soc. of Chémical Industry in Basle. 7040, 7041.

MANUFACTURE OF SATURATED, ETC., KETONES OF THE PREGNAN SERIES.—Soc. of Chémical Industry in Basle. 7044, 7045.

MANUFACTURE OF OIL-SOLUBLE RESINOUS MATERIALS, ETC.—Texaco Development Corporation. (United States, March 23, '36.) 7065.

PRODUCTION OF HIGHER UNSATURATED ALIPHATIC ALCOHOLS.—Böhme Fettchemie-Ges. (Germany, March 16, '36.) 7360.

PRODUCTION OF HIGHER UNSATURATED ALIPHATIC ALCOHOLS.—Böhme Fettchemie-Ges. (Germany, Feb. 16.) (Cognate with 7360.) 7361.

PRODUCTION OF FILMS OF ALGINIC MATERIAL.—C. W. Bonnicksen. 7419.

OVEN FOR LOW-TEMPERATURE CARBONISATION OF SOLID FUELS.—L. Boulanger. 7746.

RECOVERY OF FERROUS SULPHATE.—H. A. Brassert and Co., Ltd., and G. W. Vreeland. 7355.

DEODORANT, ETC.—British Fumigants Co., Ltd., and W. C. Slater. 7206.

EXPANDING OR EXFOLIATING VERMICULITE, ETC. SUBSTANCES.—British Zonolite Products, Ltd. (Schundler and Co.). 7847.

MANUFACTURE OF PRODUCTS CONTAINING VERMICULITE.—British Zonolite Products, Ltd. 7849.

PRODUCING PLASTIC REFRACTORY MATERIALS.—British Zonolite Products, Ltd. 7852.

FORMING PLASTIC OBJECTS.—British Zonolite Products, Ltd. 7854, 7855.

RECORDING CHANGES OF GAS PRESSURE IN AN ENCLOSURE.—Callenders Cable and Construction Co., Ltd., and A. N. Arman. 7883.

MANUFACTURE OF VAT DYESTUFFS.—A. Carpmael (I. G. Farbenindustrie.) 7153.

MANUFACTURE, ETC., OF FUNGICIDAL, ETC., AGENTS.—A. Carpmael (I. G. Farbenindustrie.) 7190.

POLYMERISATION OF UNSATURATED HYDROCARBONS.—A. Carpmael (I. G. Farbenindustrie.) 7191.

MANUFACTURE OF DIAZOTISING DYESTUFFS.—A. Carpmael (I. G. Farbenindustrie.) 7324.

PRODUCING BUTYL ALCOHOL, ETC.—Chemische Fabrik Kalk Ges., H. Glück, and A. Frey. (Germany, March 16, '36.) 7720.

PRODUCING ION-EXCHANGING MATERIALS.—J. Crosfield and Sons, Ltd., and R. Furness. 7430.

TEXTILE MATERIALS, ETC.—H. Dreyfus. 7551, 7552.

ORGANIC COMPOUNDS.—H. Dreyfus. 7695.

INSECTICIDE.—H. C. Edgecombe. 7284.

PRODUCTION OF POLYMERISABLE MATERIALS for use in manufacture of paints, etc.—J. P. Fraser. 7485.

MANUFACTURE OF AROMATIC CARBOXYLIC ACIDS.—W. W. Groves (I. G. Farbenindustrie.) 7693.

MANUFACTURE OF WATER-INSOLUBLE AZO-DYESTUFFS ON THE FIBRE.—W. W. Groves (I. G. Farbenindustrie.) 7284.

MANUFACTURE OF DYESTUFFS ON THE ANTHRAQUINONE SERIES.—W. W. Groves (I. G. Farbenindustrie.) 7828.

METAL POLISHES.—W. W. Groves (I. G. Farbenindustrie.) 7829.

PRODUCING VITREOUS, ETC., ARTICLES.—J. A. Heany. 7686.

MANUFACTURE OF THYROXIN.—I. G. Farbenindustrie. (Germany, March 13, '36.) 7429.

APPARATUS FOR DRYING, ETC., PASTES, ETC.—I. G. Farbenindustrie. (Germany, March 14, '36.) 7533.

MANUFACTURE OF ALKALI METALS.—Imperial Chemical Industries, Ltd. (United States, March 11, '36.) 7229, 7230.

PRINTING INDANTHRENE DYESTUFFS.—Imperial Chemical Industries, Ltd., and A. Davidson. 7376.

APPARATUS FOR DE-GREASING NON-ABSORBENT ARTICLES.—Imperial Chemical Industries, Ltd. 7377.

PRESSURE GAUGES.—Imperial Chemical Industries, Ltd. 7231.

MANUFACTURE OF FIBROUS SHEETS.—Imperial Chemical Industries. 7579.

SAFETY BLASTING EXPLOSIVES.—Imperial Chemical Industries, Ltd. 7694.

MANUFACTURE, ETC., OF ETHERS.—G. W. Johnson (I. G. Farbenindustrie.) 7344.

SEPARATION OF HYDROCARBON MIXTURES BY EXTRACTION.—G. W. Johnson (I. G. Farbenindustrie.) 7345.

MANUFACTURE, ETC., OF VAT DYESTUFFS.—G. W. Johnson (I. G. Farbenindustrie.) 7557.

MANUFACTURE, ETC., OF DYESTUFFS of the phthalocyanine series.—G. W. Johnson (I. G. Farbenindustrie.) 7558.

MANUFACTURE, ETC., OF ACIDS from ketones.—G. W. Johnson (I. G. Farbenindustrie.) 7559.

GENERATING REDUCING GASEOUS MIXTURE.—G. G. Johnston. (Australia, March 12, '36.) 7289.

APPARATUS FOR REMOVING DUST, ETC., FROM GASES.—O. P. T. Kantorowicz. 7314.

APPARATUS FOR MANUFACTURE OF SUPERPHOSPHATES, ETC.—R. Moritz. (France, March 17, '36.) 7902.

PRODUCING LUBRICATING OIL, ETC.—Naamlooze Venootschap de Bataafsche Petroleum Maatschappij. (Holland, March 25, '36.) 7887.

PRODUCING GASOLENES OF A HIGH ANTI-KNOCK VALUE.—Naamlooze Venootschap de Bataafsche Petroleum Maatschappij. (Holland, March 30, '36.) 7888.

ESTERS OF ACRYLIC ACID, ETC.—Rohm and Haas, A.-G. (United States, March 12, '36.) 7340.

DEPHOSPHORISING, ETC., STEEL.—Soc. d'Electrochimie d'Eletrométaux et des Acieries Électriques d'Ugine. (France, March 16, '36.) 7534.

MANUFACTURE OF INTERMEDIATE PRODUCTS AND DYESTUFFS THEREFROM.—Soc. of Chemical Industry in Basle. (Switzerland, March 11, '36.) 7172.

MANUFACTURE OF INTERMEDIATE PRODUCTS AND DYESTUFFS THEREFROM.—Soc. of Chemical Industry in Basle. (Switzerland, March 8.) (Cognate with 7172.) 7173.

MINERAL-OIL COMPOSITION, ETC.—Socony-Vacuum Oil Co., Inc. (United States, March 12, '36.) 7181.

MINERAL-OIL COMPOSITION, ETC.—Socony-Vacuum Oil Co., Inc. (United States, March 12, '36.) (Cognate with 7181.) 7182.

MINERAL-OIL COMPOSITION, ETC.—Socony-Vacuum Oil Co., Inc. (United States, March 12, '36.) (Cognate with 7181.) 7183.

PRODUCTION OF ALUMINA from clay, etc.—J. G. Stein and Co., Ltd., and J. F. Ayslop. 7787, 7788.

APPARATUS FOR STERILISING LIQUIDS.—J. R. Sterling. 7536.

COOLING, ETC., GASEOUS FLUIDS.—Superheater Co., Ltd. 7502.

COMPOSITIONS OF MATTER.—H. Sutcliffe. 7790.

OBTAINING LIQUID PRODUCTS from carbonaceous substances.—Thermogénèse. (Luxembourg, March 25, '36.) 7350.

Chemical and Allied Stocks and Shares

RATHER more activity has been reported in the industrial section of the Stock Exchange where sentiment benefited from the numerous excellent results for 1936 which have come to hand recently. Borax Consolidated deferred shares have been active on attention drawn to the scope for further improvement in profits and dividends, and are 34s. 3d. at the time of writing. At the meeting a short time ago the chairman referred to the increased demand for borax and the market is already talking of the possibility of the dividend being raised from 7½ per cent. to 9 per cent. for the current year.

Imperial Chemical have maintained the firmer tendency which developed recently, and are virtually unchanged at 39s. Salt Union remained steady and there was again a good deal of activity in Fison, Packard and Prentice, although the price has remained around 40s. General Refractories were little changed at 30s. 6d. Leeds Fireclay ordinary came in for a good deal more attention and responded in price to rumours that the company had received important orders and to hopes that it may be possible to resume dividends for the current year. The company's preference shares have been particularly active and have changed hands over 19s. British Drug Houses, Monsanto Chemical preference, and Lawes Chemical were unchanged, but prices did not appear to have been tested by much business. Sangars were firmer on continued hopes that the dividend will be at least maintained. The better tendency in Boots Pure Drug remained in evidence.

British Oil and Cake Mills preferred ordinary shares were reported to be in better demand on account of the apparently attractive yield offered and United Premier Oil and Cake ordinary continued steady on the past year's results. Unilever were well maintained at 42s. 6d., awaiting the past year's results, and Lever Brothers preference were firm on the view that the company's earnings may have shown considerable expansion in the

past year. Metal Traders have been active on hopes that the dividend and bonus distributions may be maintained, and there was partial recovery in Amalgamated Metal Corporation shares in response to the view that a company of this kind may benefit a good deal from the great activity in the metal markets ruling this year.

United Glass Bottles were steady on attention drawn to the good earning capacity of the business, and the possibility of a further increase in dividend for the current year. Canning Town Glass 5s. ordinary shares were active at 7s. 3d. on the past year's results. Triplex Safety Glass shares continued to fluctuate rather sharply, but were firmer than of late. In view of the considerably larger capital in issue it is difficult to form any very definite view as to dividend prospects, but the general belief in the market is that profits are likely to show further expansion and that very favourable dividends are likely to continue. Blythe Colour Works 4s. shares changed hands around 12s., and have been steady, the past year's results and the 17½ per cent. dividend being up to market expectations. William Blythe 3s. shares were rather lower at 6s. 10½d., hopes of a larger dividend having been disappointed, but it is likely the full results will show the 10 per cent. dividend is a conservative payment.

United Molasses were active around 31s. 7½d. on the further rise in tanker freight rates. There was better demand for British Plaster Board reported on the hope that the dividend may be maintained despite the larger capital ranking. Pinchin, Johnson and other paint shares were inclined to move in favour of holders and Wall Paper deferred were better on the belief that the forthcoming interim dividend will be unchanged. British Oxygen, Murex, and Turner and Newall were among shares which made higher prices. Oil shares improved and were active in response to renewed talk of an early increase in the price of oils.

Weekly Prices of British Chemical Products

THE only price change to report in the London chemical market is an increase of 30s. per ton in all grades of borax and boric acid. This increase also applies to the pharmaceutical grades of these products.

MANCHESTER.—A quiet resumption of business on the Manchester chemical market has been reported during the past week. Contract deliveries were suspended over the holidays, but in most instances these are proceeding steadily again, with fair quantities of textile chemicals and the other leading products being taken up in the district. Up to the present, however, there has not been a great deal in the way of new business transacted and only odd lots have been sold. Increased activity in this respect is looked for early next week, although as the majority of consumers are already well booked sellers are not greatly concerned. Prices generally are on a firm basis, with the fluctuations in the non-ferrous metals the outstanding influence at the moment. In the by-products market a steady trade is passing in most directions and values are strong.

GLASGOW.—Business in the Scottish heavy chemical market

has been very quiet over the Easter holidays. There has been a steady demand for chemicals for home trade, though export business still remains limited. Prices generally continue very firm at about previous figures, though lead and copper products were rather easier in the early part of the week, on account of the lower prices then ruling for the metals. Tartaric acid and cream of tartar are again dearer, on account of the scarcity and high price of the raw material. Transactions in coal tar products have been limited on account of the Easter holidays, but in the main the tone of the market continues very firm. Further forward sales of cresylic acid have been booked at prices showing advances on last week's figures, and to-day's quotations for sale 97/99 average from 4s. 4d. to 4s. 8d. per gallon f.o.r. buyer's packages. Distilled 60's carbolic has been offered at a fraction over 4s. per gallon, and high boiling tar acids about 2s. 6d. per gallon, with available supplies somewhat limited in both cases. Creosote is very steady, and it seems probable that recent tenders invited for further supplies may be negotiated at a basic price round 6d. per gallon f.o.r.

General Chemicals

ACETONE.—£45 to £47 per ton.	IODINE.—Resublimed B.P., 5s. 1d. per lb.
ACID, ACETIC.—Tech., 80%, £30 5s. to £32 5s. per ton; pure 80%, £30 5s.; tech., 40%, £15 12s. 6d. to £18 12s. 6d.; tech., 60%, £23 10s. to £25 10s. MANCHESTER: 80%, commercial, £30 5s.; tech. glacial, £42 to £46.	LEAD ACETATE.—LONDON: White, £35 10s. per ton; brown, £35. GLASGOW: White crystals, £34 to £35; brown, £1 per ton less. MANCHESTER: White, £38; brown, £37.
ACID, BORIC.—Commercial granulated, £28 10s. per ton; crystal, £29 10s.; powdered, £30 10s.; extra finely powdered, £32 10s. in 1-cwt. bags, carriage paid home to buyers' premises within the United Kingdom in 1-ton lots. GLASGOW: Crystals, £29 10s.; powdered, £30 10s.	LEAD NITRATE.—£39 per ton.
ACID, CHROMIC.—94d. per lb., less 2½%; d/d U.K.	LEAD, RED.—SCOTLAND: £44 10s. per ton less 2½%, carriage paid, for 2-ton lots.
ACID, CITRIC.—1s. per lb. MANCHESTER: 1s. SCOTLAND: B.P. crystals, 1s. per lb., less 5%, ex store.	LEAD (WHITE SUGAR OF).—GLASGOW: £37 10s. per ton net, ex store.
ACID, FORMIC.—85% in carboys, ton lots, £42 to £47 per ton.	LITHARGE.—SCOTLAND: Ground, £44 10s. per ton, less 2½%, carriage paid for 2-ton lots.
ACID, HYDROCHLORIC.—Spot, 5s. to 7s. 6d. carboy d/d according to purity, strength and locality.	MAGNESITE.—SCOTLAND: Ground calcined, £9 per ton, ex store.
ACID, LACTIC.—LANCASHIRE: Dark tech., 50% by vol., £24 10s. per ton; 50% by weight, £28 10s.; 80% by weight, £50: pale tech., 50% by vol., £28; 50% by weight, £33; 80% by weight, £55; edible, 50% by vol., £41. One-ton lots ex works, barrels free.	MAGNESIUM CHLORIDE.—SCOTLAND: £7 10s. per ton.
ACID, NITRIC.—80° Tw. spot, £18 to £25 per ton makers' works.	MAGNESIUM SULPHATE.—Commercial, £5 per ton, ex wharf.
ACID, OXALIC.—£48 15s. to £57 10s. per ton, according to packages and position. GLASGOW: £2 9s. per cwt. in casks. MANCHESTER: £49 to £55 per ton ex store.	MERCURY.—Ammoniated B.P. (white precip.), lump, 5s. 1d. per lb.; powder B.P., 6s. 1d.; dichloride B.P. (corros. sub.) 5s. 2d.; powder B.P. 4s. 10d.; chloride B.P. (calomel), 5s. 1d.; red oxide cryst. (red precip.), 7s.; levig. 6s. 6d.; yellow oxide B.P. 6s. 4d.; persulphate white B.P.C., 6s. 1d.; sulphide black (hyd. sulph. cum sulph. 50%), 6s. For quantities under 112 lb., 1d. extra.
ACID, SULPHURIC.—168° Tw., £4 5s. to £4 15s. per ton; 140° Tw., arsenic-free, £2 15s. to £3 5s.; 140° Tw., arsenious, £2 10s.	METHYLATED SPIRIT.—61 O.P. industrial, 1s. 5d. to 2s. per gal.; pyridinised industrial, 1s. 7d. to 2s. 2d.; mineralised, 2s. 6d. to 3s. Spirit 64 O.P. is 1d. more in all cases and the range of prices is according to quantities. SCOTLAND: Industrial 64 O.P., 1s. 9d. to 2s. 4d.
ACID, TARTARIC.—1s. 1d. per lb. less 5%, carriage paid for lots of 5 cwt. and upwards. MANCHESTER: 1s. 0½d. to 1s. 1d. per lb. ALUM.—Loose lump, £8 7s. 6d. per ton d/d; GLASGOW: Ground, £10 7s. 6d. per ton; lump, £9 17s. 6d.	PARAFFIN WAX.—SCOTLAND: 3½d. per lb.
ALUMINIUM SULPHATE.—£7 per ton d/d Lancs.; GLASGOW: £7 to £8 ex store.	PHENOL.—6½d. to 7½d. per lb.
AMMONIA, ANHYDROUS.—Spot, 10d. per lb. d/d in cylinders. SCOTLAND: 10d. to 1s. containers extra and returnable.	POTASH, CAUSTIC.—LONDON: £42 per ton. MANCHESTER: £39.
AMMONIA, LIQUID.—SCOTLAND: 80°, 2½d. to 3d. per lb., d/d.	POTASSIUM BICHROMATE.—SCOTLAND: 5d. per lb., less 5%, carriage paid.
AMMONIUM BICHROMATE.—8d. per lb. d/d U.K.	POTASSIUM CHLORATE.—£36 7s. 6d. per ton. GLASGOW: 4½d. per lb. MANCHESTER: £38 per ton.
AMMONIUM CARBONATE.—£20 per ton d/d in 5 cwt. casks.	POTASSIUM IODIDE.—B.P. 4s. 3d. per lb.
AMMONIUM CHLORIDE.—LONDON: Fine white crystals, £16 10s. (See also Salammoniac.)	POTASSIUM NITRATE.—£27 per ton. GLASGOW: Refined granulated, £29 per ton e.i.f. U.K. ports. Spot, £30 per ton ex store.
AMMONIUM CHLORIDE (MURIATE).—SCOTLAND: British dog tooth crystals, £32 to £35 per ton carriage paid according to quantity. (See also Salammoniac.)	POTASSIUM PERMANGANATE.—LONDON: 9½d. per lb. SCOTLAND: B.P. Crystals, 9½d. MANCHESTER: B.P. 11d. to 1s.
ANTIMONY OXIDE.—£55 10s. per ton.	POTASSIUM PRUSSATE.—6½d. per lb. SCOTLAND: 7d. net, in casks, ex store. MANCHESTER: Yellow, 6½d. to 6¾d.
ARSENIC.—LONDON: £13 10s. per ton e.i.f. main U.K. ports for imported material; Cornish nominal, £22 10s. f.o.r. mines SCOTLAND: White powdered Cornish, £18, ex store. MANCHESTER: White powdered Cornish, £18, ex store.	SALAMMONIAC.—First lump spot, £41 17s. 6d. per ton d/d in barrels. GLASGOW: Large crystals, in casks, £38.
BARIUM CHLORIDE.—£10 per ton. GLASGOW: £11 5s. per ton.	SALT CAKE.—Unground, spot, £3 16s. 6d. per ton.
BISULPHITE OF LIME.—£6 10s. per ton f.o.r. London.	SODA ASH.—58% spot, £5 12s. 6d. per ton f.o.r. in bags.
BLEACHING POWDER.—Spot, 35/37%. £8 15s. per ton in casks, special terms for contracts. SCOTLAND: £9.	SODA, CAUSTIC.—Solid, 76/77° spot, £12 10s. per ton d/d station. SCOTLAND: Powdered 98/99%, £17 10s. in drums, £18 5s. in casks, Solid 76/77°, £14 12s. 6d. in drums; 76/73%, £14 12s. 6d., carriage paid buyer's station, minimum 4-ton lots; contracts 10s. per ton less.
BORAX COMMERCIAL.—Granulated, £16 per ton; crystal, £17; powdered, £17 10s.; extra finely powdered, £18 10s., packed in 1-cwt. bags, carriage paid home to buyers' premises within the United Kingdom in 1-ton lots. GLASGOW: Granulated, £16; crystal, £17; powdered, £17 10s. per ton in 1-cwt. bags, carriage paid.	SODA CRYSTALS.—Spot, £5 to £5 5s. per ton d/d station or ex depot in 2-cwt. bags.
CALCIUM CHLORIDE.—Solid 70/75% spot, £5 5s. per ton d/d station in drums. GLASGOW: 70/75% solid, £5 10s. per ton net ex store.	SODIUM ACETATE.—£18 per ton carriage paid North. GLASGOW: £18 10s. per ton net ex store.
CHROMETAN.—Crystals, 2½d. per lb.; liquor, £19 10s. per ton d/d CREAM OF TARTAR.—£3 19s. per cwt. less 2½%. GLASGOW: 99%, £4 7s. per cwt. in 5-cwt. casks.	SODIUM BICARBONATE.—Refined spot, £10 10s. per ton d/d station in bags. GLASGOW: £12 15s. per ton in 1 cwt. kegs, £11 per ton in 2-cwt. bags. MANCHESTER: £10 10s.
FORMALDEHYDE.—£22 10s. per ton.	SODIUM BICHROMATE.—Crystals cake and powder 4d. per lb. net d/d U.K. discount 5%. MANCHESTER: 4d. per lb. GLASGOW: 4d., less 5% carriage paid.
GLYCERINE.—Chemically pure, double distilled, 1.260 s.g., in tins, £7s. 6d. to £6 7s. 6d. per cwt. according to quantity; in drums, £5 to £5 13s. 6d.	SODIUM BISULPHITE POWDER.—60/62%, £20 per ton d/d 1 cwt. iron drums for home trade.
	SODIUM CARBONATE, MONOHYDRATE.—£15 per ton d/d in minimum ton lots in 2 cwt. free bags.
	SODIUM CHLORATE.—£26 10s. to £30 per ton. GLASGOW: £1 10s. per cwt.
	SODIUM CHROMATE.—4d. per lb. d/d U.K.

SODIUM HYPOSULPHATE.—Commercial, 2 ton lots d/d, £10 5s. per ton; photographic, £14 5s. MANCHESTER: Commercial, £10; photographic, £14 10s.
SODIUM METASILICATE.—£14 per ton, d/d U.K. in cwt. bags.
SODIUM NITRATE.—Refined, £7 10s. per ton for 6-ton lots d/d.
SODIUM NITRITE.—£18 5s. per ton for ton lots.
SODIUM PERBORATE.—10%, 4d. per lb. d/d in 1-cwt. drums.
SODIUM PHOSPHATE.—£13 per ton.
SODIUM PRUSSIATE.—4d. per lb. for ton lots. GLASGOW: 5d. to 5½d. ex store. MANCHESTER: 4½d. to 4¾d.
SODIUM SILICATE.—£9 10s. per ton.
SODIUM SULPHATE (GLAUBER SALTS).—£3 per ton d/d.
SODIUM SULPHATE (SALT CAKE).—Unground spot, £3 12s. 6d. per ton d/d station in bulk. SCOTLAND: Ground quality, £3 5s. per ton d/d. MANCHESTER: £3 5s.
SODIUM SULPHIDE.—Solid 60/62%, Spot, £11 5s. per ton d/d in drums; crystals 30/32%, £8 15s. per ton d/d in casks. MANCHESTER: Concentrated solid, 60/62%, £11; commercial, £8.
SODIUM SULPHITE.—Pea crystals, spot, £13 5s. per ton d/d station in kegs. Commercial spot, £8 15s. d/d station in bags.
SULPHATE OF COPPER.—£20 per ton, less 2%, in casks. MANCHESTER: £26 10s. per ton f.o.b. SCOTLAND: £26 per ton less 5%, Liverpool, in casks.
SULPHUR PRECIP.—B.P., £55 to £60 per ton according to quantity. Commercial, £50 to £55.
ZINC SULPHATE.—Crystals, £9 per ton, f.o.r., in bags.

Rubber Chemicals

ANTIMONY SULPHIDE.—Golden, 6½d. to 1s. 1d. per lb., according to quality. Crimson, 1s. 5½d. to 1s. 7d. per lb., according to quality.
ARSENIC SULPHIDE.—Yellow, 1s. 5d. to 1s. 7d. per lb.
BARYTES.—£6 to £7 10s. per ton, according to quality.
CADMIUM SULPHIDE.—6s. to 6s. 3d. per lb.
CARBON BISULPHIDE.—£31 to £33 per ton, according to quantity, drums extra.
CARBON BLACK.—3 11/16d. to 4 13/16d. per lb., ex wharf.
CARBON TETRACHLORIDE.—£41 to £46 per ton, according to quantity, drums extra.
CHROMIUM OXIDE.—Green, 1s. 2d. per lb.
DIPHENYLGUANIDINE.—2s. 2d. per lb.
INDIA-RUBBER SUBSTITUTES.—White, 4½d. to 5d. per lb.; dark, 3d. to 4½d. per lb.
LAMP BLACK.—£22 to £23 per ton d/d London; vegetable black, £28 to £48.
LEAD HYPOSULPHITE.—9d. per lb.
LITHOPONE.—30%, £16 10s. to £17 5s. per ton.
SULPHUR.—£9 to £9 5s. per ton. SULPHUR PRECIP. B.P., £55 to £60 per ton. SULPHUR PRECIP. COMM., £50 to £55 per ton.
SULPHUR CHLORIDE.—5d. to 7d. per lb., according to quantity.
VERMILION.—Pale, or deep, 5s. 3d. per lb., 1-cwt. lots.
ZINC SULPHIDE.—10d. to 11d. per lb., according to quality.

Nitrogen Fertilisers

SULPHATE OF AMMONIA.—Neutral quality, basis 20.6 per cent. nitrogen, delivered in 6-ton lots to farmer's nearest station, £7 5s. per ton.
CALCIUM CYANAMIDE.—£7 5s. per ton, carriage paid to any railway station in Great Britain in lots of four tons and over.
NITRO-CHALK.—£7 5s. per ton for delivery to end of June.
NITRATE OF SODA.—£7 12s. 6d. per ton for delivery up to end of June.
AMMONIUM PHOSPHATE FERTILISERS.—£10 5s. to £13 15s. per ton for delivery up to end of June, delivered in 6-ton lots to farmer's nearest station.

Coal Tar Products

ACID, CRESYLIC.—97/99%, 4s. 6d. to 4s. 7d. per gal.; 99/100%, 4s. 10d. to 5s. 2d., according to specification; pale 99%, 4s. 8d. to 4s. 9d.; dark, 3s. 10d. to 4s. GLASGOW: Pale, 99/100%, 4s. 6d. to 4s. 10d. per gal.; pale 97/99%, 4s. 4d. to 4s. 8d.; dark, 97/99%, 3s. 6d. to 3s. 10d.; high boiling acids, 2s. 4d. to 2s. 8d. American specification, 3s. 6d. to 4s. MANCHESTER: Pale, 99/100%, 4s. 8d.
ACID, CARBOLIC.—Crystals, 7d. to 7½d. per lb.; crude, 60s. 3s. 3d. to 3s. 6d. per gal. MANCHESTER: Crystals, 7½d. per lb.; crude 3s. 4d. per gal. GLASGOW: Crude, 60s. 3s. 2d. to 3s. 8d. per gal.; distilled, 60s. 4s. to 4s. 1d.
BENZOL.—At works, crude, 9½d. to 10d. per gal.; standard motor 1s. 3d. to 1s. 3½d.; 90%, 1s. 4d. to 1s. 4½d.; pure, 1s. 8d. to 1s. 8½d. LONDON: Motor, 1s. 3½d. GLASGOW: Crude, 9½d. to 10½d. per gal.; motor, 1s. 4d. to 1s. 5d.
CREOSOTE.—B.S.I. Specification standard, 5½d. to 6d. per gal. f.o.r. Home, 3½d. d/d. LONDON: 4½d. f.o.r. North: 5d. London. MANCHESTER: 5½d. to 6d. GLASGOW: B.S.I. Specification 5½d. to 6d. per gal.; washed oil, 5d. to 5½d.; lower sp. gr. oils, 5d. to 5½d.
NAPHTHA.—Solvent, 90/160%, 1s. 7d. to 1s. 8d. per gal.; 95/160%, 1s. 7d. to 1s. 8d.; 90/190%, 1s. 2d. to 1s. 3d. LONDON: Solvent, 1s. 3½d. to 1s. 4d.; heavy, 11d. to 1s. 0½d. f.o.r. GLASGOW: Crude, 6d. to 6½d. per gal.; 90% 160, 1s. 6d. to 1s. 7d. 90% 190, 1s. 1d. to 1s. 2d.

NAPHTHALENE.—Crude, whizzed or hot pressed, £12 to £13 per ton; purified crystals, £18 to £20 per ton in 2-cwt. bags. LONDON: Fire lighter quality, £5 to £5 10s. per ton; crystals, £27 to £27 10s. GLASGOW: Fire lighter, crude, £6 to £7 per ton (bags free). MANCHESTER: Refined £23 per ton f.o.b.

PYRIDINE.—90/140%, 8s. 6d. to 9s. 6d. per gal.; 90/180, 2s. 6d. to 3s. GLASGOW: 90% 140, 9s. to 10s. per gal.; 90% 160, 7s. to 8s.; 90% 180, 2s. 6d.

TOLUOLE.—90%, 2s. per gal.; pure, 2s. 5d. GLASGOW: 90%, 12s. 1s. 10d. to 1s. 11d. per gal.

PITCH.—Medium, soft, 36s. to 37s. per ton, in bulk at makers' works. MANCHESTER: 35s. f.o.b., East Coast. GLASGOW: f.o.b., Glasgow, 28s. 6d. to 35s. per ton; in bulk for home trade, 32s. 6d.

XYLOL.—Commercial, 2s. 2d. per gal.; pure, 2s. 4d. GLASGOW: Commercial, 1s. 11d. to 2s. per gal.

Wood Distillation Products

ACETATE OF LIME.—Brown, £8 10s. to £9 per ton; grey, £10 10s. to £11 10s. Liquor, brown, 30° Tw., 6d. to 8d. per gal.

MANCHESTER: Brown, £9 10s.; grey, £11 10s.

CHARCOAL.—£5 10s. to £11 per ton, according to grade and locality.

METHYL ACETONE.—40-50%, £42 to £45 per ton.

WOOD CREOSOTE.—Unrefined 6d. to 1s. 6d. per gal., according to boiling range.

WOOD, NAPHTHA, MISCELL.—2s. 9d. to 3s. 3d. per gal.; solvent, 3s. 6d. to 3s. 9d. per gal.

WOOD TAR.—£2 10s. to £4 per ton.

Intermediates and Dyes

ACID, BENZOIC, 1914 B.P. (ex toluol).—1s. 9½d. per lb. d/d buyer's works.

ACID, GAMMA.—Spot, 4s. per lb. 100% d/d buyer's works.

ACID, H.—Spot, 2s. 4½d. per lb. 100% d/d buyer's works.

ACID NAPHTHIONIC.—1s. 8d. per lb.

ACID, NEVILLE AND WINTHROP.—Spot, 3s. per lb. 100%.

ACID, SULPHANILIC.—Spot, 8d. per lb. 100%, d/d buyer's works.

ANILINE OIL.—Spot, 8d. per lb., drums extra, d/d buyer's works.

ANILINE SALTS.—Spot, 8d. per lb. d/d buyer's works, casks free.

BENZIDINE, HCl.—2s. 5d. per lb., 100% as base, in casks.

m-CRESOL. 98/100%. 1s. 8d. to 1s. 9d. per lb. in ton lots.

o-CRESOL. 30/31° C.—6½d. to 7½d. per lb. in 1-ton lots.

p-CRESOL. 34-5° C.—1s. 7d. to 1s. 8d. per lb. in ton lots.

DICHLORANILINE.—2s. 3d. per lb.

DIMETHYLANILINE.—Spot, 1s. 6d. per lb., package extra.

DINITROBENZENE.—7½d. per lb.

DINITROTOLUENE.—48/50° C., 8½d. per lb.; 66/68° C., 10d.

DIPHENYLAMINE.—Spot, 2s. per lb., d/d buyer's works.

o-NAPHTHOL.—Spot, 2s. 4d. per lb., d/d buyer's works.

β-NAPHTHOL.—In bags, £88 15s. per ton; in casks, £89 15s.

α-NAPHTHYLAMINE.—Lumps, 1s. per lb.; ground, 1s. 0½d. in casks.

β-NAPHTHYLAMINE.—Spot, 2s. 9d. per lb., d/d buyer's works in casks.

o-NITRANILINE.—3s. 11d. per lb.

m-NITRANILINE.—Spot, 2s. 7d. per lb., d/d buyer's works.

p-NITRANILINE.—Spot, 1s. 8d. to 2s. 1d. per lb. d/d buyer's works.

NITROBENZENE.—Spot, 4½d. to 5d. per lb., in 90-gal. drums, drums extra. 1-ton lots d/d buyer's works.

NITRONAPHTHALENE.—9d. per lb.; P.G., 1s. 0½d. per lb.

SODIUM NAPHTHIONATE.—Spot, 1s. 9d. per lb., 100% d/d buyer's works.

o-TOLUIDINE.—10½d. per lb., in 8/10-cwt. drums, drums extra.

p-TOLUIDINE.—1s. 10½d. per lb., in casks.

m-XYLIDIN ACETATE.—4s. 3d. per lb., 100%.

Latest Oil Prices

LONDON, March 31.—**LINSEED OIL** was firm. Spot, £32 5s. (small quantities); April, £29 17s. 6d.; May-Aug., £30 2s. 6d.; Sept.-Dec., £30 7s. 6d., naked. **SOYA BEAN OIL** was steady. Oriental (bulk), afloat, Rotterdam, £28 15s. **RAPE OIL** was firm. Crude, extracted, £36; technical refined, £37, naked, ex wharf. **COTTON OIL** was steady. Egyptian crude, £30; refined common edible, £33 10s.; deodorised, £35 10s., naked ex mill (small lots £1 10s. extra). **TURPENTINE** was quiet. American, spot, 39s. 6d. per cwt.

HULL.—**LINSEED OIL**, spot, quoted £30 10s. per ton; March and April, £30; May-Aug., £30 5s.; Sept.-Dec., £30 10s. **COTTON OIL**, Egyptian, crude, spot, £30 10s.; edible, refined, spot, £33 5s.; technical, spot, £33 5s.; deodorised, £35 5s., naked. **PALM KERNEL OIL**, crude, f.m.q., spot, £34, naked. **GROUND-NUT OIL**, extracted, spot, £33 10s.; deodorised, £36 10s. **RAPE OIL**, extracted, spot, £33; refined, £36. **SOYA OIL**, extracted, spot, £33 10s.; deodorised, £36 10s. per ton. **COD OIL**, f.o.r. or f.a.s., 27s. 6d. per cwt., in barrels. **CASTOR OIL**, pharmaceutical, 45s. 6d.; first, 40s. 6d.; second, 38s. 6d. **TURPENTINE**, American, spot, 41s. 6d. per cwt.

Forthcoming Events

LONDON

Apr. 7.—Society of Public Analysts. "Quantitative Microscopical Analysis of Feeding Stuffs. 1. Determination of Rye, Wheat and Barley Starches in Mixtures. Ground Oat Mixtures." J. G. A. Griffiths. "The Hartridge Reversion Spectroscopic Improvements in Design, Assembly and Technique." R. C. Frederick. "The Properties of Calciferol." F. W. Anderson, A. L. Bacharach and E. Lester Smith. "Mannich's Process for the Determination of Morphine." 8 p.m. Rooms of the Chemical Society, Burlington House, Piccadilly, London.

Apr. 7.—Electrodepositors' Technical Society and Faraday Society. Joint meeting. 8.15 p.m. Northampton Polytechnic Institute, St. John Street, Clerkenwell, London.

Apr. 7.—Institute of the Plastics Industry. (London Section). Section annual meeting and prize papers. British Industries House Club, Marble Arch, London.

Apr. 8.—Institute of Metals. (London Section). Annual general meeting and open discussion. 7.30 p.m. Rooms of the Society of Motor Manufacturers and Traders, Ltd., 83 Pall Mall, London.

Apr. 9.—Physical Society. Ordinary meeting. 5 p.m. Imperial College of Science and Technology, South Kensington, London.

Apr. 9.—Institution of Chemical Engineers and Chemical Engineering Group. "Costing Problems in the Chemical Industry." H. R. Odling. 8 p.m. Rooms of the Chemical Society, Burlington House, Piccadilly, London.

BIRMINGHAM

Apr. 6.—Electrodepositors' Technical Society. (Birmingham Section.) "Health Risks in the Finishing Trades." E. R. A. Merewether. 7.30 p.m. James Watt Memorial Institute, Great Charles Street, Birmingham.

Apr. 8.—Society of Chemical Industry. (Birmingham Section.) Jubilee Memorial Lecture. "The Service of Science to Industry." Dr. J. T. Dunn. 7.30 p.m. University Buildings, Edmund Street, Birmingham.

LIVERPOOL

Apr. 8.—Institute of Chemistry. (Liverpool Section.) Annual general meeting. "Let's Go Somewhere." G. Brearley. 7.30 p.m. Constitutional Club, India Buildings, Water Street, Liverpool.

MANCHESTER

Apr. 9.—Oil and Colour Chemists' Association. (Manchester Section.) Annual general meeting and hot pot supper. 7 p.m. Manchester Ltd. Restaurant, Cross Street, Manchester.

Company News

Worthington-Simpson.—A dividend of 7 per cent., less tax, is announced for 1936.

William Blythe and Co.—A final dividend of 7 per cent., making 10 per cent., less tax (same) is announced.

Newton Chambers.—A final dividend of 10 per cent., making 15 per cent., less tax (12½ per cent.) is recommended.

Bede Metal and Chemical.—The net profit for 1936 is £10,243 (against £4,104); add £8,350 brought in, making £18,593; dividend 6d. per share (3d.); reserve for replacements £1,000 (£2,000); reserve £5,000; forward £8,231.

J. and E. Atkinson.—The accounts for 1936 shows that profit amounts to £37,428 (£26,695); add £7,617 brought in, making £45,045. The dividend on the ordinary shares is 5 per cent., less tax, (3½ per cent.); to general reserve, £20,000 (£14,597); forward, £7,045.

Canning Town Glass.—The net trading for 1936 amounts to £50,188 (£40,091); add £10,342 brought in, making £60,530. To depreciation reserve, £10,000 (same); to general reserve, £7,500 (same); to dividend equalisation fund, £5,000 (nil); development account, £1,500 (£1,000); special writing down of certain specific items included in plant and machinery, £1,250; dividend of 7 per cent. (6 per cent.); forward, £10,168.

A. and F. Pears.—The report for 1936 shows profit £77,441, add brought forward £25,484, making £102,926. The dividend is 12½ per cent. on the ordinary shares; forward £27,526. Since the last annual meeting Mr. Robert Pears has retired from the board, and Mr. C. S. Roads has been appointed as a director on the nomination of the preference and preferred ordinary shareholders. The company is controlled by Lever Brothers, Ltd.

Blythe Colour Works.—The report for period January 25, 1936 (date of incorporation), to December 31, 1936, shows that net profit for year ended December 31, 1936, after providing for depreciation, amounts to £35,718; deduct profit prior to incorporation £2,237, leaving £33,481. To income-tax £6,882; preference dividend for period February 1 to September 30, 1936, £4,000; interim ordinary dividend £3,750, leaving £18,849. To general reserve £5,000; final ordinary dividend of 12½ per cent. actual, making 17½ per cent.; forward £4,474, subject to preference dividend accrued to December 31, 1936, amounting to £1,500.

Lever Bros.—A dividend of 15 per cent., less tax, for 1936, on the ordinary stock is announced. All the £8,500,000 of stock is held by Unilever, Ltd. This is the same as that paid in the preceding four years. In addition to the ordinary stock, there is in issue £30,577,099 in 7 per cent. cumulative preference stock, £15,505,173 in 8 per cent. cumulative "A" preference stock, £3,787,312 in 20 per cent. cumulative preferred ordinary stock, and £3,000,000 in 20 per cent. cumulative "A" preferred ordinary stock.

Van den Berghs and Jurgens.—The report for 1936 is the first statement following the amalgamation of Van den Berghs, Ltd., with Jurgens, Ltd., and van den Berghs and Jurgens (Sales), Ltd., which took place last year. The total profit for the year was £578,116, and after deducting £4,925 for general management expenses and £44,078 for depreciation, there remains a balance of £529,113. With the balance brought in and a net profit of £418,912 from Jurgens, Ltd., transferred under the agreement, the total is raised to £1,073,309. Tax taken £100,018, and preference and preferred dividends £226,995. The directors recommend a dividend of 7 per cent. on the ordinary stock, placing £200,000 to reserve, and carrying £266,167 forward.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

County Court Judgments

(Note.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for damages or otherwise, and the result of bona-fide contested actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days. When a debtor has made arrangements with his creditors we do not report subsequent County Court Judgments against him.)

DAWSON, A. T. (male), 41 Joseph Street, Bradford, oil manufacturer (trading as A. Dawson and Co.). (C.C., 3/4/37.) £22 8s. 6d. February 24.

PINKNEY, WM., 191 Ayresome Street, Middlesbrough, chemical foreman, and **SPENCER, JNO.**, 2 High Street, Normanby, tile setter foreman. (C.C., 3/4/37.) £18 3s. 6d. February 26.

New Companies Registered

Sigma Products, Ltd.—Registered March 3. Nominal capital £2,100. Manufacturers of, agents for, and dealers in, patent medicines, proprietary articles, chemicals, etc. Subscribers George Hey, "Moorcroft," Ferrybridge Road, Pontefract, C.A.; and W. Beck.

Farina Dextrin, Ltd.—Registered March 11. Nominal capital, £20,000. Manufacturers of, and dealers in, pastes, glues, gums, glue stocks, adhesives, dextrine, farina, chemicals, oils, colours, size, fertilisers, etc. Subscribers: C. W. Pletschette, 54 Lonsdale Road, S.W.13, and J. Coulson.

J. V. Rushton (London), Ltd.—Registered March 10. Nominal capital, £5,000. To construct and work plants for anodising, more particularly to Air Ministry specification, in association with J. V. Rushton (Wolverhampton), Ltd., and J. V. Rushton (Birmingham), Ltd. (when incorporated), and generally for the protection and colouring of aluminium and its alloys; to carry on business as anodisers, metal finishers, depositors and sprayers, chemical manufacturers, workers and dealers, etc. Subscribers: John V. Rushton, 134 Mount Road, Penn, Wolverhampton, and Mrs. F. Rushton.

Chemical Trade Inquiries

The following trade inquiries are abstracted from the "Board of Trade Journal." Names and addresses may be obtained from the Department of Overseas Trade (Development and Intelligence), 35 Old Queen Street, London, S.W.1 (quote reference number).

United States.—An agent in New York desires to obtain the representation of United Kingdom exporters of chemicals, edible and other oils. (Ref. No. 24.)

Belgium and Duchy of Luxemburg.—A general agent established at Brussels wishes to obtain the representation, on terms to be arranged, of United Kingdom manufacturers of chemical and pharmaceutical products. (Ref. No. 10.)

Belgium and Duchy of Luxemburg.—A wholesale firm established at Brussels wish to obtain the representation of United Kingdom manufacturers of glues, chemicals and paints. They would buy for their own account and eventually on consignment for immediate delivery. (Ref. No. 11.)

